Department of Water Resources
Delta Emergency Operations Plan
Concept Paper

April 2007

TABLE OF CONTENTS

Tables

Figures

Appendices

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ACRONYMS

BDO	Bay-Delta Office
CALFED	California Bay-Delta Program
Caltrans	California Department of Transportation
CCC	California Conservation Corps
CCWD	Contra Costa Water District
CDF	California Department of Forestry and Fire Protection
CDFG	California Department of Fish and Game
CDO	Central District Office
CEQA	California Environmental Quality Act
CHP	California Highway Patrol
CNG	California National Guard
CNRFC	California/Nevada River Forecast Center
CVP	Central Valley Project
CWC	California Water Code
Delta	Sacramento-San Joaquin Delta
DES	Division of Environmental Services
DFM	Division of Flood Management
DOE	Division of Engineering
DOSD	Division of Safety of Dams
DPLA	Division of Planning and Local Assistance
DRMS	Delta Risk Management Strategy
DWR	Department of Water Resources
EBMUD	East Bay Municipal Utility District
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
ER&R	Emergency Response and Repair
FEMA	Federal Emergency Management Agency
FOC	Flood Operations Center
ICS	Incident Command System
JOC	Joint Operations Center
LMA	Levee Maintaining Agency
MOU	Memorandum of Understanding
MWD	Metropolitan Water District
NIMS	National Incident Management System
NRP	National Response Plan
NWS	National Weather Service

ACRONYMS (Continued)

OA	Operational Area
OCO	Operations Control Office
OES	Governor's Office of Emergency Services
O&M	Division of Operations and Maintenance
PG&E	Pacific Gas & Electric
PL	Public Law
REOC	Regional Emergency Operations Center
SEMS	Standardized Emergency Management System
SOC	State Operations Center
SOP	Standard Operating Procedure
SWP	State Water Project
SWRCB	State Water Resources Control Board
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USBR-CVO	United States Bureau of Reclamation–Central Valley Operations
USCG	United States Coast Guard
USGS	United States Geological Survey
WAM	Water Analysis Module
WAPA	Western Area Power Administration

1.0 Introduction

The Sacramento-San Joaquin Delta (Delta), (Figure 1-1) located within the Central Valley, California, is an important resource for agricultural, urban, industrial, environmental, and recreational uses. About two-thirds of Californians, mainly in the Bay Area and Central and Southern California, drink water from the Delta. The Delta provides a portion of the irrigation water to about 3 million acres of agricultural land. Within the Delta, there are approximately 1,115 miles of levees protecting 700,000 acres of lowland areas that include approximately 60 islands.

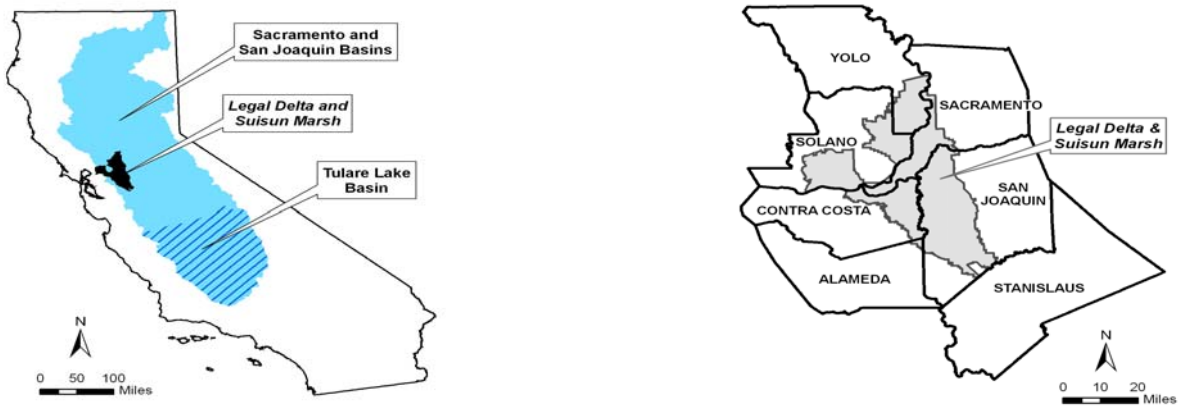


Figure 1-1 Legal Delta and County Boundaries

Source: Delta Risk Management Strategy, 2007.

During the last century, there have been over 160 levee failures (Figure 1-2) leading to island inundations. In addition to threatening life and property and disrupting the economy on a local level, island failures in the Delta could threaten the distribution of water throughout central and southern California by allowing seawater from San Francisco Bay to enter areas that are critical to the distribution of freshwater. The proximity of the Delta to active earthquake faults heightens the risk of levee failures on multiple islands, possibly leading to shutdown of the water distribution system.

Given the risk and potential statewide impact of Delta levee failures, the State of California has undertaken several major initiatives to define the risk of levee failure and improve physical systems and response capabilities necessary to reduce the impact of such an event. As part of this effort, California's Department of Water Resources (DWR) has initiated the development of an Emergency Operations Plan (EOP), a plan that provides procedures for emergency preparedness and incident management activities typically necessary for a jurisdiction and/or organization with emergency response roles and responsibilities. While DWR has current general procedures for emergency response, the EOP will ultimately enhance the State's ability to prepare for, respond to, and recover from a Delta levee failure disaster and will provide DWR with a plan focused specifically on a catastrophic levee failure disaster. The EOP will be a blueprint for coordinating the protection of life and property with its local, State, and Federal partners in taking the steps necessary to protect the State's water system.

The development of the EOP is occurring in two phases:

- In the first phase, DWR has conducted a discovery process to analyze previously developed plans and procedures and to identify current DWR capabilities for response to emergencies and disasters in the Delta. Through that process, DWR has categorized response actions that can be taken to reduce the impact of a Delta levee failure disaster. The first phase, now complete, has resulted in this concept paper.
- In the second phase, DWR will engage its partners in local, State, and Federal government, and in the private sector, to develop a detailed EOP for responding to levee failure events, stabilizing the system, and facilitating recovery. The EOP will be consistent and in compliance with California's Standardized Emergency Management System (SEMS)[1] and with the National Incident Management System (NIMS)[1]. Through the process of developing the EOP, DWR will improve preparedness capabilities for response and recovery.

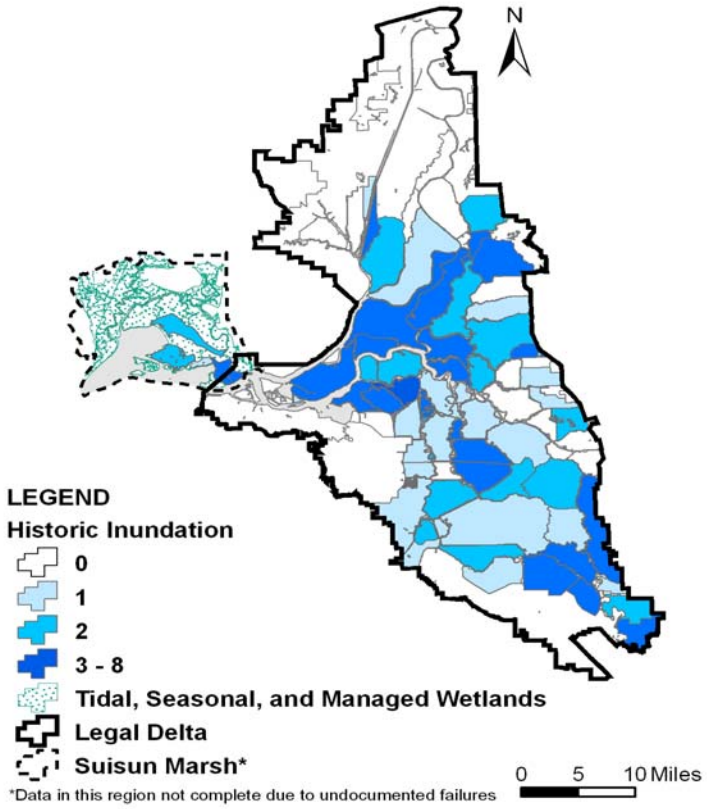


Figure 1-2 Island Inundation from Levee Failures Since 1900

Source: Delta Risk Management Strategy, 2007.

[1] SEMS is an emergency management system required by California Government Code Section 8607(a) for managing incidents involving multiple jurisdictions and agencies. NIMS is a nationwide, Federal emergency management approach, for managing incidents with all levels of government, private-sector, and nongovernmental organizations working together. For further SEMS/NIMS information, please visit this website: http://www.oes.ca.gov/Operational/OESHome.nsf/1?OpenForm

1.1 Purpose of the Concept Paper

Within the past 20 years, DWR and other local, State, and Federal agencies have undertaken a wide range of planning activities to address the potential consequences of levee failure in the Delta. This concept paper documents the results of DWR's evaluation of these existing plans and procedures, whether developed by DWR or others. Through the evaluation process, DWR has also identified those actions that might be effective in reducing the impact of Delta levee failures, given current resources and existing relationships with other agencies that have responsibility for emergency response in the Delta. The concept paper provides a compilation of these actions and gives DWR a plan for undertaking a response with currently available resources. If one or more levee failures were to occur in the immediate future, DWR could implement the measures outlined in the concept paper to reduce the impact of the failures.

The paper also demonstrates the need for more comprehensive planning and investments to enhance response capabilities, not just within DWR but also among the local, State, and Federal agencies and others who have a stake in the preservation of the Delta. Therefore, the concept paper lays the foundation for development of a comprehensive EOP by defining existing circumstances and providing the context in which the planning process can proceed. The paper also provides recommendations for system improvements that may eventually enhance DWR's response capabilities; moreover, these recommendations provide the initial components of an improvement plan that will be developed as part of the EOP process.

1.2 Scope of the Concept Paper

The scope of this document is defined by the following parameters:

- **Responsible Agency:** The concept paper focuses on DWR's roles, responsibilities, and actions in response to a Delta levee failure disaster. It is understood that DWR will coordinate with the Governor's Office of Emergency Services (OES), local government emergency management agencies, customers for water delivery, and others in the response to such an event. In developing the comprehensive EOP, DWR will incorporate key partners into the planning process. The concept paper also applies to all DWR divisions and programs that would have responsibility for providing resources during the response to, and recovery from, a Delta levee failure disaster.
- **Triggering Event:** A multiple levee failure event, as later described in Section 3, could have several causes, including earthquakes (either within or in close proximity to the Delta), floods, structural collapse, or human-caused events. However, given the potentially devastating consequences of a massive earthquake during the dry season and the consequences to the water supply, the concept paper outlines responses to that type of event.
- **Geography:** The concept paper focuses on the failure of levees in the legal Delta, although it is recognized that such an event could have a statewide impact. The paper does not reflect actions taken in response to earthquake damage to other area water systems, such as San Francisco's Hetch Hetchy system or other portions of the State Water Project (SWP), nor does it consider disasters affecting water systems in other parts of California.

1.3 Authorities, Regulations, and Requirements

Government Code Section 8607 of the California Emergency Services Act provides DWR with broad authority to participate in all aspects of emergency response within the SEMS structure.

Section 128 of the Water Code gives DWR broad authority to conduct flood emergency response and recovery operations. In addition to DWR's role under the California Emergency Services Act, Section 128 gives DWR the following permissive authority:

128. (a) In times of extraordinary stress and of disaster, resulting from storms and floods…the department may perform any work required or take any remedial measures necessary to avert, alleviate, repair, or restore damage or destruction to property having a general public and State interest and to protect the health, safety, convenience, and welfare of the general public of the State. In carrying out that work, the department may perform the work itself or through or in cooperation with any other state department or agency, the Federal government, or any political subdivision, city, or district.

The legal authority for DWR response to a flood emergency and its emergency powers are also described in the following sections of the California Water Code (CWC).

- Section 128(b): States that DWR's emergency powers do not override the authority of the Director of OES.
- The CWC also gives DWR authority to respond to emergency situations related to dam failures (CWC § 6110 – 6113) or levee repair work within the Delta.
- Sections of the CWC (§ 8645 - 8647) and Government Code (§ 8550 et seq.) define special flood related emergency powers to the Governor and the State Reclamation Board, which in turn have the ability to make emergency related actions and delegate response work to DWR.

Through the Delta Levees Program, DWR administers the Delta Levees Subventions Program (Water Code Section 12980 et seq.) and Special Flood Control Projects Program (Water Code Section 12300 et seq.), which provide year-round flood control assistance to local Delta districts for levee maintenance and improvement projects. The Subventions Program is legislatively authorized to provide up to $200,000 per year to Delta levee maintaining agencies in amounts not to exceed $50,000 per emergency levee site (Water Code Section 12994). Additionally, the Special Flood Control Projects Program may provide funds for emergencies and ongoing levee rehabilitation projects. Special Flood Control Projects has discretionary authority to supplement emergency projects not covered by the Subventions Program.

The following plans also provide direction and guidance for DWR's role when responding to levee failures in the Delta:

- *State – Federal Flood Operations Center, Flood Emergency Operations Manual*. State of California, The Resources Agency, Department of Water Resources, Division of Flood Management. February 2002.
- *Standardized Emergency Management System Guidelines*. State of California, Governor's Office of Emergency Services. January 2001.
- *State of California Emergency Plan*. State of California, Governor's Office of Emergency Services. September 2005.
- Governor's Executive Orders, W-9-91 and W-156-97, State of California. 1991-1997.

Other key State statutes and regulations that have a bearing on DWR emergency response actions are summarized in Table 1-1.

Table 1-1 Key Statues and Regulations

Type	Statute/Regulation	Summary
Emergency Response Definition	California Code of Regulations Title 19, Section 2402	Defines emergency response agencies.
Governor's Emergency Authority	Government Code Section 8550 et seq.	Make and rescind orders and regulations. Expend any appropriation. Suspend provisions of any regulatory statue. Commandeer private property (except media) or personnel. Enlist DWR and other agencies for emergency purposes.
DWR Emergency Authority	Water Code Section 128(a) Water Code Section 128(a) Water Code Section 6110-6113	Gives DWR authority to take remedial actions to avert, alleviate, repair, or restore damage or destruction to property having a public or state interest. Places overall authority in emergency response with OES. Allows DWR to take remedial measures to protect life and property if a dam is about to fail.
SEMS	Government Code Section 8607(d) California Code of Regulations Title 19, Section 2403 California Code of Regulations Title 19, Section 2405 California Code of Regulations Title 19, Section 2407	Requires all state agencies to use a standard emergency response system. Describes how state agencies need to incorporate SEMS. Models SEMS on the ICS. Establishes communications and coordination procedures during an emergency.
Emergency Plans and Mutual Aid Agreements	Government Code Section 8610 Government Code Section 8616 Government Code Section 8617 Government Code Section 8618	Allows local governments to develop emergency plans and mutual aid agreements. Requires DWR aid given to local agencies to follow existing local plans. Allows DWR to provide mutual aid in periods other than emergencies. States that local agency remains in charge of incident, unless aid-giving agency states otherwise.
Responsibility for Sacramento and San Joaquin Flood Control Projects	Water Code Section 8370, 12642 Water Code Section 8361, 12878.1 Water Code Section 8715	Assigns responsibility for Sacramento and San Joaquin Flood Control Projects to local levee maintaining districts, counties, cities, and other public agencies. Authorizes DWR to maintain and operate portions of flood control projects in the Sacramento and San Joaquin Valleys. Gives general authority to DWR to protect or strengthen any levee between Chico and Fresno.
Federal Cooperation	Water Code Section 12642 Public Law 84-99	Gives authority to maintain and operate Federally authorized projects to DWR and public districts if the Federal government is inactive. Authorizes USACE to conduct emergency flood fight after Governor's request to aid DWR.
Debris Disposal	Government Code Section 8596	State agencies and employees may assist in disposal of debris on private property.
CEQA Exemptions	Public Resources Code Section 21080	Authorizes emergency repair to public facilities. Exempts actions to prevent/mitigate an emergency.
Emergency Contracting Provisions	Public Contract Code Section 10122	Permits DWR to use contracts on informal bids to effect emergency repairs.
Stream Bed Alteration Agreements	Fish and Game Code	Allows DWR to perform emergency work with a

Type	Statute/Regulation	Summary
	Section 1601(f)	notice to CDFG within 14 days of work.
California Endangered Species Act	Fish and Game Code Section 2090(c)	Allows DWR to perform emergency work with a notice to CDFG within 14 days of work.
Wetlands Regulation	Clean Water Act Section 404	Regional permit guidelines.
Emergency Volunteers/Good Samaritan Laws	Government Code Section 820.2, 825, 8655, 8657, 8659, 8660	Provides immunity from liability to good faith volunteers pressed into emergency response service.

CDFG = California Department of Fish and Game
CEQA = California Environmental Quality Act
DWR = Department of Water Resources
ICS = Incident Command System
OES = Governor's Office of Emergency Services
SEMS = Standardized Emergency Management System
USACE = United States Army Corps of Engineers

Source: DWR Emergency Powers by Ward A. Tabor, Senior Staff Counsel, January 2000.

2.0 Priorities

DWR's mission is to manage the water resources of California in cooperation with other agencies to benefit the State's people and to protect, restore, and enhance the natural and human environments[2]. In accordance with its mission, DWR will respond to a multiple levee failure disaster in the Delta according to the following priorities.

- **Protection of life, property, and infrastructure:** Assist local government and State agencies with missions to reduce immediate threats posed by levee failures and flooding to life, public health and safety, and public and private property, including critical infrastructure.
- **Protection of water quality and water supply:** Lead statewide efforts to ensure the continued operation of the water supply system and restore the system to pre-disaster operations.
- **Protection of the environment:** Implement response actions in a manner that minimizes adverse environmental consequences where possible, and ensures that restoration of Delta ecosystems is considered during recovery.

[2] http://www.water.ca.gov/about/

3.0 Sacramento-San Joaquin Delta Risks

3.1 Delta Risk Identification

The Delta environment, its infrastructure, and its availability as a source of water, are subject to a wide range of threats. These threats include toxic spills, salinity intrusion during droughts, ecosystem risks, water quality degradation (such as disinfection byproducts), risks to water supply reliability due to pumping restrictions (in response to endangered species risks), and an event that causes multiple levee failures. Forces that can cause an event in which multiple islands are flooded include:

- Extreme high tides, often in combination with high winds;
- Large floods due to high inflows from one or more tributary rivers; and
- Earthquakes.

This document focuses on an event in which multiple islands are flooded due to levee failure during a period of moderate to low Delta inflow. Such an event represents the most critical circumstance with regard to water supply; it would result in a significant increase in salinity, impeding the ability of Delta water users to irrigate crops and preventing the export of water from the Delta by users such as the Contra Costa Water District (CCWD), the SWP, the Central Valley Project (CVP), and East Bay Municipal Utility District (EBMUD), which is vulnerable to levee failure but does not export water from the Delta. The disruption of water use could be prolonged, depending on the volume of inflow to the Delta at the time of the event and the number and location of the islands flooded. The widespread impact of a multiple island event would also present challenging circumstances in terms of response and resource management and coordination.

Levee failures during large floods do not generally pose an immediate threat to water supply. This is because the large flood inflows (fresh water) hold salinity downstream into Suisun Bay or beyond. Delta water use and exports would not be adversely impacted, at least until flood flows subside. If flooded islands cannot be repaired within several months, Delta salinity may increase due to tidal mixing during the next low flow season and additional emergency measures may be required. However, several months would be available to plan for the implementation of such measures.

In contrast, an event in which multiple islands are flooded during a period of moderate to low Delta inflow would have immediate and dramatic impacts on Delta salinity. During such an event, the islands (with surfaces 10 to 20 feet below sea level) would draw substantial volumes of saline water into the Delta from Suisun Bay. (For a complete list of islands within the Delta and their potential flood volume, see Appendix A.) That saline water would flow throughout Delta channels, causing a prolonged disruption of local and export water use. In addition, islands flooded with salt water become sources of salinity until the breaches are closed and can add salinity to Delta channels as the islands are dewatered. Because the risk of a catastrophic event is greater due to an earthquake than an extreme high tide/high wind event, this document assumes an event caused by an earthquake.

3.2 The Delta Risk Management Strategy

To assess the potential risks associated with levee failures in the Delta, the State of California has initiated development of the Delta Risk Management Strategy (DRMS). The DRMS project originated with the 2000 California Bay-Delta Program (CALFED) Record of Decision, which included, as the preferred program alternative, the development of a strategy for sustainability that included an assessment of major risks to Delta resources from floods, seepage, subsidence, and earthquakes. DRMS would also evaluate

the consequences of levee failure and develop recommendations to manage the risk. DRMS includes the following geographic areas:

- Suisun Marsh east of the Benicia-Martinez Bridge on Interstate 680; and
- Sacramento-San Joaquin Delta as legally defined in Section 12220 of the CWC.

Specifically, DRMS will evaluate the risk and consequences associated with failure of the Delta and Suisun Marsh levees and other assets, considering their exposure to all hazards (including seismic, flood, subsidence, seepage, and climate change) under present and foreseeable future conditions. The evaluation will assess the total risk, as well as a disaggregation of the risk to individual islands. DRMS will also include a prioritized list of actions to reduce and manage the risks or consequences associated with Delta levee failures.

The first phase of DRMS, which consisted of the development of a risk analysis, is essentially complete. The risk analysis and evaluation included the assessment of various Delta assets and infrastructure, which resulted in detailed geographic maps. For a sample of these maps and figures, see Appendix B. The second phase, which will consist of the development of an inventory of measures to reduce risk, will be completed in November 2007. The resulting analyses will provide DWR with scenarios that can be used to identify desired response capabilities and gaps in capabilities, and to develop recommendations for improvements.

The DRMS risk analysis considers levee failures due to natural hazards, such as earthquakes and floods, as well as normal (sunny day) failures and considers the effects of saltwater intrusion from San Francisco Bay into the Delta as a result of levees breaching and islands flooding. Emergency response and repair operations and Delta water quality are simulated using models (currently under development) in order to determine the time duration of the disruption to water export, which in turn leads to estimates of economic and environmental consequences.

DRMS Emergency Response and Repair Model

The risk analysis consists of a number of interconnected models with specified tasks. One model is tasked with modeling emergency response and repair (ER&R) operations, which involve not only repair but also levee stabilization to minimize further damage. The ER&R model estimates the time, material, and pumping capacity required, and the associated costs to stabilize damaged levee sections, prevent further damage, close breaches, and dewater flooded islands following an event. The ER&R model handles any number of levee breaches and/or damaged levee sections following an event; other models can determine the potential location and number of breeches. The result of the ER&R model is the time required to achieve a return to normal water export. This result is then inputted into water quality, economics, and environmental models to complete the risk assessment.

Following an event, there may be a number of islands flooded, simply damaged, or both. Islands that experience damage but no flooding require remediation in order to avoid a breach at a later time as a result of overtopping. The risk analysis models the likelihood of a later breach; its impact is accounted for in the material and time estimates if repair of the damaged section does not occur before the likely occurrence of the breach. On flooded islands, the breaches require capping and filling, eventually followed by island dewatering. Furthermore, flooded islands are susceptible to interior levee slope erosion resulting from exposure to wind-driven wave action and must be protected against this erosion. Erosion rates depend on the wind vulnerability of a particular section of levee, which is based on the fetch and exposure of that particular section of levee to the predominant wind direction. The ER&R model can

simulate erosion on the levee's interior slopes that will act throughout the repair period. This erosion manifests itself as additional damage, resulting in larger quantities of rock required when repair of that section proceeds.

The analysis has the ability to assess the effectiveness of various emergency response and repair strategies. A significant level of flexibility is provided in the ER&R module in terms of developing the repair work order for a given event. This level of flexibility allows the user complete definition of a work order, to the point where the order of task completion is defined across islands and repair types. The start and end times of each of the repairs are recorded as they occur, as well as the quantity of rock placed, volume of water pumped, and associated cost.

Depending on the time of year, there may be other flood fighting activities taking place in the Delta, which are not related to an event. These activities may detract resources from the event-related response, and are included in the analysis. The module can also be used to evaluate other variables affecting levee material supplies such as rock stockpiling and quarry outage scenarios, among others.

DRMS Water Analysis Module

Using the results of the ER&R Module and other input on the timing and nature of the event, the Water Analysis Module (WAM) simulates upstream reservoir operations, Delta water operations, net Delta area consumptive water use, Delta hydrodynamics and water quality (salinity), Delta exports, net Delta outflow, and south of the Delta water allocations, all as impacted by the levee breach incident. The model is designed to start (have event initiation occur) during any month or type of water year. It draws on CalSim as a baseline for the beginning state of the water system and calculates deviations from the conditions that would have occurred without the levee breach incident. Based on these impacts, it is able to calculate if water exports are possible and the length of time exports may be disrupted. It also calculates if water quality will be suitable for agricultural irrigation on each Delta island that is not flooded and when salinity will be reduced sufficiently to resume irrigation.

WAM is innovative and flexible. It is a one-dimensional model patterned after a two-dimensional model and calibrated based on existing two- and three-dimensional models. Whereas the multi-dimensional models require days or weeks for a single simulation, WAM can complete a breach event simulation in less than 2 minutes. This provides flexibility for considering a wide variety of potential month and water year start times and a wide variety of breach locations and combinations of flooded islands.

WAM's biggest advantage may be its incorporation of water management decision-making. This allows implementation of upstream reservoir management rules that determine whether water is available for flushing releases and, if it is, initiates the release sending water to the Delta. The hydrodynamic model then responds by calculating a salinity distribution that reflects the flushing and dilution that the extra water provides and considers whether part of that water can be allocated to exports. WAM is programmed so that releases are not overdone; enough water is saved to conserve for future years (which may be dry) and to protect upstream and environmental uses.

Finally, based on the disruption or limited ability to export through State and Federal water project pumps, WAM allocates the restricted supply available from partial pumping and storage. This allows a DRMS economics module to calculate the economic impacts of reductions in water supply. WAM results are also used by an ecosystem model to evaluate Delta environmental impacts due to the levee breach event.

3.3 Multi-Island Failure Scenario

In order to provide a tangible basis for developing the EOP, a seismically driven multi-island failure during the late summer is assumed. There is a wide range of potential scenarios that could be adopted. The main basis of choice is to provide an obviously challenging example rich in problems, difficulties, coordination needs, and potential response actions. Particular interest has been expressed in advance planning for a major event that could be initiated by a large earthquake occurring close enough to the Delta to flood many islands. Accordingly, a scenario involving approximately 20 islands will be examined in detail. The goal, however, is to provide an emergency management approach that DWR can adjust in scale to address any particular event that actually occurs.

If an earthquake occurs that causes strong ground shaking in the Delta, the locations most likely to be affected are the western and southwestern portions of the Delta. These areas are closer to potential earthquake sources and are therefore more likely to experience more intense shaking. Flooding of these islands is also more likely to interfere with fresh water conveyance to export pumps. Several documents and presentations have introduced the idea of large multi-island events (DWR, 2005[3] and JBA, 2005[4]). In previous work by DWR on behalf of CALFED, Sherman Island was identified as the island with the weakest levees relative to seismic shaking and therefore the island with the greatest susceptibility to a seismically driven failure (CALFED, 2000)[5]. Other islands in the western and central Delta were also found to have a medium to medium-high susceptibility to failure. Accordingly, a scenario such as the one shown in Figure 3-1 could result from a strong earthquake in or near the Delta. Table 3-1 shows the islands that would be flooded in such a scenario, with each island's number of breaches indicated.

Table 3-1 Examples of Flooded Islands and Number of Breaches

Island	# of breaches	Island	# of breaches
Bacon	2	McDonald	1
Bethel	2	Orwood	2
Bouldin	1	Palm	2
Bradford	1	Quimby	1
Brannon/Andrus	2	Sherman Island	20
Byron	1	Twitchell	1
Holland	2	Upper Jones	1
Jersey	4	Venice	1
Lower Jones	1	Victoria	1
Mandeville	1	Webb	1

Source: URS, 2007.

[3] DWR, 2005. "How a Delta Earthquake Could Devastate California's Economy." Testimony by Lester Snow, Director, California Department of Water Resources to the Senate Subcommitte on Delta Resource, Senate Transportation and Housing Committee and Joint Committee on Emergency Services and Homeland Security. November 1, 2005.

[4] Jack R. Benjamin & Associates, Inc. 2005. "Preliminary Seismic Risk Analysis Associated with Levee Failures in the Sacramento – San Joaquin Delta." Prepared for California Bay-Delta Authority and California Department of Water Resources. Prepared by Jack R. Benjamin & Associates, Inc. in association with Resource Management Associates and Economic Insights. June, 2005

[5] CALFED, 2000. CALFED Bay-Delta Program, Levees and Channels Technical Team, Levees Seismic Vulnerability Sub-Team. *Seismic Vulnerability of the Sacramento – San Joaquin Delta Levees*. April, 2000.

During the second phase development of the EOP, this scenario may be refined and additional scenarios may be developed.

As stated in Section 3.1, the time of year and the Delta inflow regime are also critical to the severity of the event, in terms of impact to water supply. Late summer and early fall tend to be the low-flow times of year. For this scenario, August 1 has been tentatively chosen for the date of the event. The flow regime for 1993 presents the following analytical advantages:

- Although that year had more water than normal, the preceding several years were quite dry, thereby providing additional challenges such as the need for project water users to rebuild their local surface water storage and recharge groundwater basins and extensive replanting in drought-impacted areas.
- The 1993-1994 winter proved to be quite dry, a fact that was not known in August 1993 but provides an interestingly "unlucky" set of developments to be dealt with as the scenario goes forward.

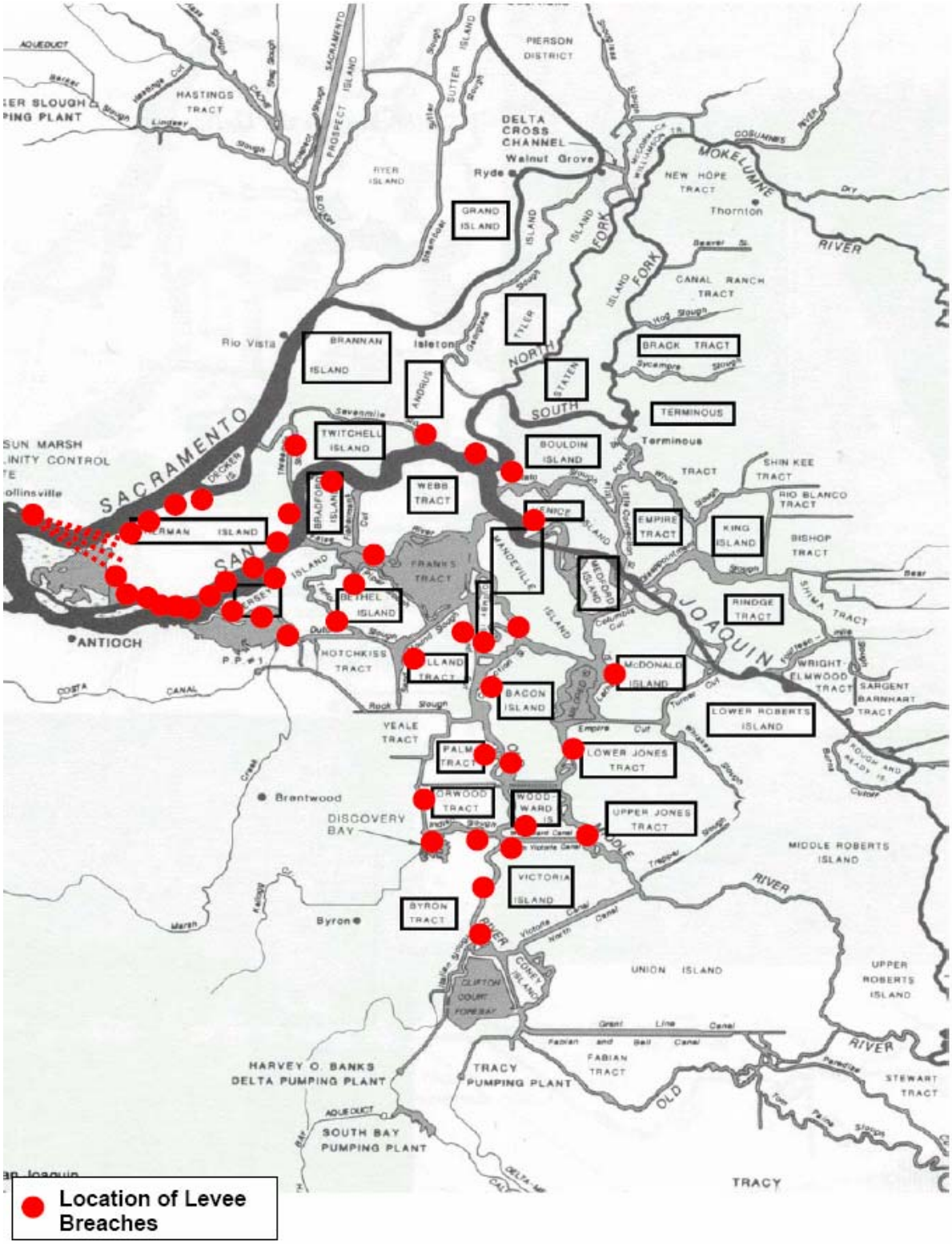


Figure 3-1 Multi-Island Failure Scenario – Levee Breach Locations

Source: Jack Benjamin & Associates, 2007.

4.0 DWR Emergency Management Structure

Following a catastrophic event in the Delta, the initial DWR response would focus on short-term emergency response, with an emphasis on saving lives and protecting property. Groups within DWR with emergency response capabilities would take an organizational lead in DWR's response to the event. These groups and their response roles include:

- **Division of Flood Management (DFM)** – Takes the lead to manage DWR's flood emergency response and manages Sections under the Flood Operations Branch of DFM that provide key resources during flood emergencies. Those Sections are as follows:
  - Emergency Response Section
  - Flood Project Inspection Section
  - Forecasting Section
  - California Data Exchange Center
  - Maintenance Yards
- **Division of Operations and Maintenance (O&M)** – Coordinates activities at each incident with the FOC. O&M Emergency Response Teams are established within each Field Division of DWR, to provide a SEMS-based emergency response organizational structure.
- **Division of Planning and Local Assistance (DPLA), Central District Office (CDO)** – Manages water resources in cooperation with local, State, and Federal agencies and all public interests. Collects and analyzes data by planning for future water management actions and by providing technical and financial assistance. Manages four District offices, organized by geographic responsibilities, which maintain close contact with local interests and agencies, and carry out responsibilities specific to their geographical regions and problem areas. The CDO, located in Sacramento, has personnel trained in SEMS and provides expertise in flood plain management, geology, stream flow measurement, high water surveying, and flood fighting. The CDO provides assistance to the following counties:

Table 4-1 Central District Counties

Alameda	Sacramento
Alpine	San Francisco
Amador	San Joaquin
Calaveras	San Mateo
Contra Costa	Santa Clara
El Dorado	Sierra
Marin	Solano
Mendocino	Sonoma
Mono	Sutter
Napa	Tuolumne
Nevada	Yolo
Placer	Yuba

Source: URS, 2007.

There are other groups within DWR, such as the Bay-Delta Office (BDO), Division of Environmental Services (DES), Division of Engineering (DOE), and Division of Safety of Dams (DSOD), who may be called upon to lend assistance in accordance with their respective areas of operation and expertise.

The DWR emergency management structure is based on SEMS and is set up to allow easy communication between different DWR divisions that may have different responsibilities during a flood emergency. As illustrated on Figure 4-1, at the onset of an emergency, DFM will activate the FOC. Upon activation of the FOC, DWR may also send representatives to other emergency operations centers (EOCs), such as the State Operations Center (SOC), Regional Emergency Operations Center (REOC), or Operational Area (see definition under Section 4.3.1.3) EOC, depending on local need and the severity of the event. DFM operates the FOC and plays the largest role within the Department for coordinating the flood fight effort. As DFM coordinates the flood fight effort to protect life safety and minimize damage, they are also concerned with taking action to protect water supply and water quality. Other DFM personnel and personnel from other division's within DWR will model the effects of levee failures on water supply and water quality. Water samples will be collected and data inputted in salinity and water quality models to project the effects of levee failures on water quality and water supply. The output of these models will help guide the response effort and provide valuable input to O&M in order to coordinate with water reservoir operators and Delta exporters to take actions to prevent and minimize saltwater intrusion. Once the necessary response actions have been taken to minimize loss of life, damage to property, and adverse affects to water supply and water quality, DWR will transition to the recovery phase and determine the order in which levees are to be repaired and islands are to be recovered. DWR will use its Interim Levee Repair Policy to guide these determinations. Figure 4-1 illustrates a simplified response timeline; the response actions and the future EOP will provide more information on proper response actions and the timeline for these actions and will be further developed in later stages of this EOP development process.

As the focus of the event shifts from short-term emergency response to addressing the long-term consequences of the event, the responsibility for managing DWR's operations shifts away from the emergency response groups to the daily operations and long-term planning groups. This shift in operational responsibility during the course of the event is shown in Figure 4-1.

In order to carry out the Department's mission and primary goals, DWR is responsible for flood forecasting, technical analysis, warning dissemination, public information, and flood management activities. The following paragraphs detail these activities.

River Forecasts

From about mid-October through April, a joint State-Federal forecast team continuously monitors river stages and weather conditions to maintain awareness of any high water potential. As major storm systems approach California, forecasters from the National Oceanic and Atmospheric Administration, National Weather Service (NWS) River Forecast Center, and DWR forecast the location, amount, and timing of expected precipitation and make initial river forecasts. Once the storm arrives and runoff begins forecasts are updated and issued as necessary. Reservoir operators adjust flood control releases as inflows increase or downstream channels swell with runoff. If runoff is sufficient to raise streams to threatening levels the NWS and DWR issue these forecasts as official public bulletins. Automated NWS and DWR computer systems disseminate bulletins and FOC personnel make high water notification calls to selected agencies. Depending on the severity of forecast or actual flooding, DWR may declare a Flood Alert or Flood Mobilization.

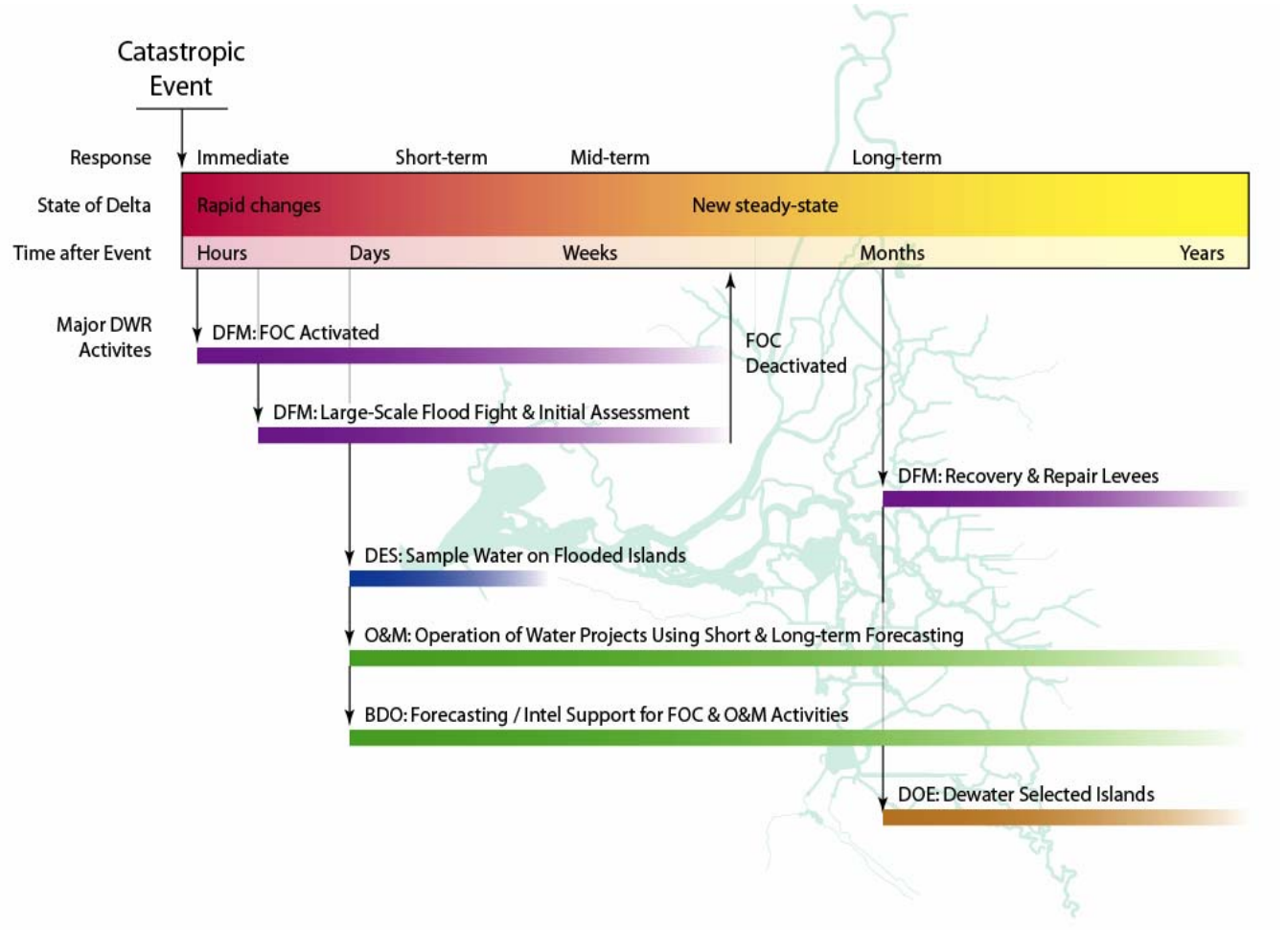


Figure 4-1 Example DWR Response Timeline

Source: DWR, 2007.

In the event of a Delta emergency, these upstream river forecasts are critical to both the short and long-term repair and recovery efforts in the Delta. NWS and DWR forecasting efforts can be expanded to use additional tools to predict the hourly water levels in all Delta channels. DWR long-term water supply forecasts are also useful in assessing storage changes in upstream reservoirs. Together, these real-time and long-term forecasts can be used to determine the effectiveness of emergency response options and to establish priorities for levee repairs. Because a multi-island failure would likely exceed DWR's ability to repair all breaches at the same time, real-time forecasts and previous long-term Delta planning studies would be crucial tools in prioritizing repairs to emphasize those repairs that are most beneficial in improving the conveyance capabilities of the Delta.

High Water Notifications

When streams are forecast to rise above certain pre-determined stages (water surface elevations) or flow rates, FOC personnel make high water notification calls to appropriate local flood system maintaining and emergency response agencies. Maintaining agencies are required to patrol their levees on a 24-hour basis as long as the water level is at or above the high level monitoring stage and until no levee threat remains.

In the event of a large-scale failure of Delta levees, it may be necessary to expand these patrols to islands and levees in the Delta that did not fail during the event.

Flood Alert
Forecasts of sustained storm patterns and flood potential, the need for coordinated field operations, and requests for technical support from local agencies may require the Flood Operations Branch Chief to declare a Flood Alert to officially activate the FOC under SEMS. DFM personnel from the Flood Operations and Hydrology Office, NWS Sacramento Forecast Office, and when applicable the Information Services Branch of DWR's Public Affairs Office, expand their regular duties to meet these needs as they begin to staff the positions in the FOC. If additional personnel are needed, they are first obtained from within the DFM and then from other areas in DWR.

Flood Mobilization
Additional DWR personnel, equipment, material, and financial resources may be needed for extended periods to respond to sustained severe storms and flooding. The Director of DWR may declare a Flood Mobilization to meet this need. DFM is authorized to use any DWR personnel and expenditures beyond budgeted funding during a Flood Mobilization. Flood Alerts and Mobilizations are internal levels of response within DWR and are independent from local, State, or Presidential emergency declarations. In the case of a multi-island failure within the Delta, DWR would coordinate its emergency response with a number of other agencies (see Section 4.4).

4.1 DFM Emergency Response Organization

The mission of DFM is to prevent loss of life, reduce property damage caused by floods, and assist in recovery efforts following any natural disaster. The FOC assumes the lead for central management when DWR responds to any flood event within the State. The FOC serves as the facility from which DWR can centrally coordinate emergency response and is the focal point for the gathering, analysis, and dissemination of flood and water-related information.

In accordance with SEMS, the FOC uses an organizational structure based on the Incident Command System (ICS)[6]. As shown in Figure 4-2, the FOC is organized into five ICS organizational groups:

- Management;
- Operations;
- Planning and Intelligence;
- Logistics; and
- Finance and Administration.

Once activated, the FOC remains staffed 24 hours a day through the duration of the emergency event. The FOC is headed by DWR's Chief of Flood Operations, who becomes the Incident Commander for flood-fighting operations. The other positions within the FOC are then filled with other DFM employees and volunteers from other DWR divisions.

[6] ICS is a standardized management concept, typically in the field of emergency services, specifically designed to allow its users to adopt an integrated organizational structure equal to the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. www.w0ipl.com/ECom/icsterms.htm

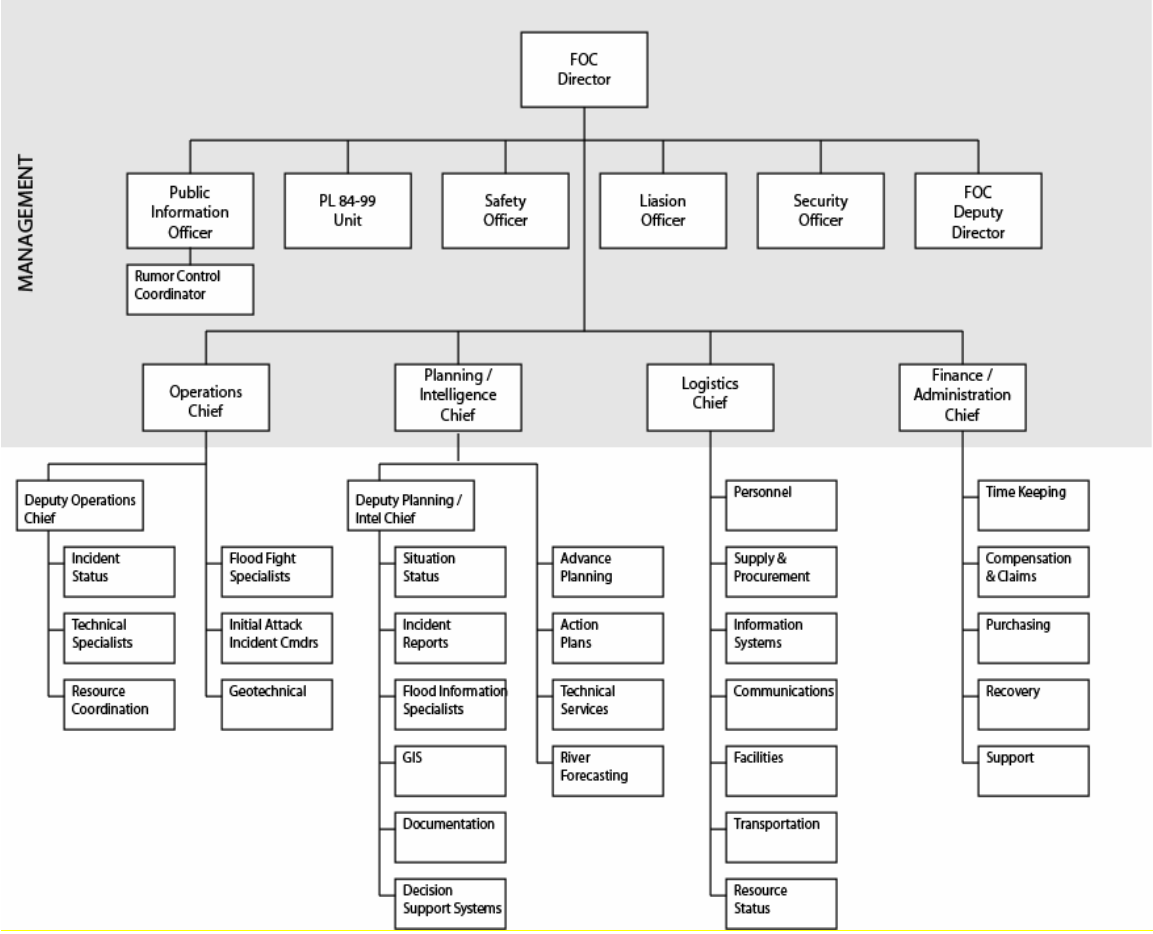


Figure 4-2 Flood Operations Center Organizational Structure

Source: DWR, 2007.

4.2 O&M Emergency Organization

The O&M Operations Control Office (OCO) has an Incident Action Plan to deal with emergency situations. Under this plan, the OCO acts as an EOC to support field activities. As mandated, the EOC is organized according to SEMS, the organizational structure of which is similar to the FOC organization shown in Figure 4-2. Once activated, the EOC remains staffed 24 hours a day throughout the duration of the emergency event.

4.3 Coordinating with Other Agencies

During a flood emergency, DWR coordinates its activities with other local, State, and Federal agencies. DWR's FOC is routinely staffed with DWR, DFM, and NWS employees in a Joint Operations Center (JOC) located in Sacramento. DWR O&M, United States Bureau of Reclamation– Central Valley Operations (USBR-CVO), and the United States Army Corps of Engineers (USACE) also have access to the FOC and can coordinate their operations through the FOC. Under normal conditions, DWR O&M and USBR-CVO coordinate their day-to-day operations and also participate in event specific weather briefings put on by the FOC. During a flood event, many other State and Federal agencies send special representatives to the FOC, where their representatives work to coordinate their respective organization's

activities with the DWR flood fight. Some of these representatives, such as the USACE and the State Reclamation Board, have their own dedicated resources within the FOC and sit with FOC management. These representatives not only work to coordinate larger efforts between groups, but also serve as advisors to DWR's flood response. Other agencies, such as the United States Geologic Survey (USGS), OES, California Department of Forestry and Fire Protection (CDF), local government representatives, and representatives from other DWR groups work directly with the Operations and Planning/Intelligence Sections. Additional DWR staff can be assigned to aid any of these representatives as needed.

4.3.1 DWR Core Partners

In planning, or in response to a catastrophic emergency, DWR will be required to communicate with multiple partners. This section introduces those partners and identifies some of the ways they will be working with DWR, either through flood fighting efforts or water supply operations. In accordance with SEMS, emergency management occurs at local, State, and Federal levels. The following subsections identify core Federal, State, local, and public agencies, whom DWR partners with. Subsequent sections will identify other stakeholders that DWR coordinates with to a lesser extent.

The agencies with which DWR cooperates during typical flood emergencies are identified on Figure 4-3.

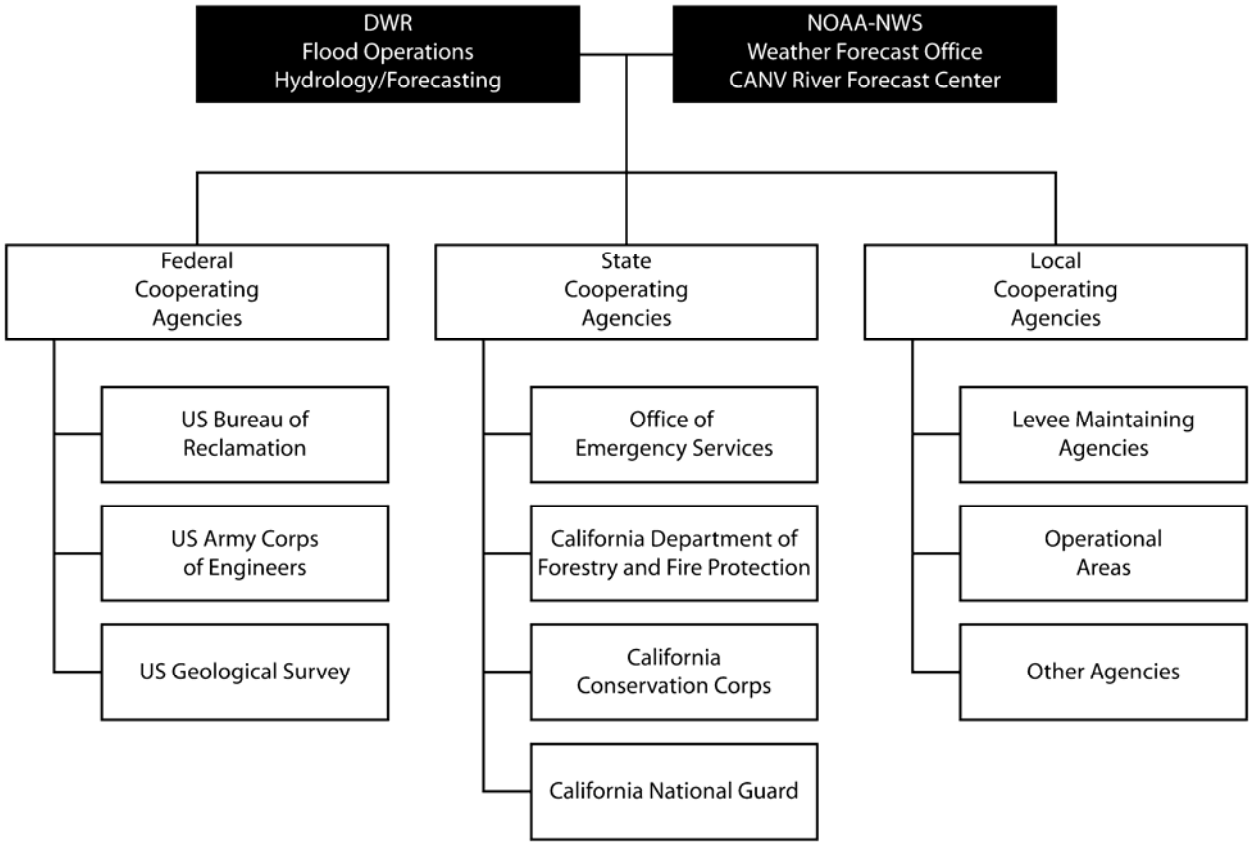


Figure 4-3 Agencies that Cooperate with DWR During Typical Flood Emergencies

Source: DWR, 2007.

4.3.1.1 Federal Agencies

USACE
The USACE is authorized under Public Law (PL) 84-99 to provide assistance with flood fighting and the rehabilitation of flood control projects. PL 84-99 authorizes the USACE to:

- Provide emergency flood fight assistance on local levees that either protect populated areas or public infrastructure or have pre-qualified for PL 84-99 by meeting USACE structural criteria.
- Rehabilitate flood control structures damaged or destroyed by floods, if those structures meet certain design and maintenance criteria and have been enrolled in the Rehabilitation and Inspection Program.
- Rehabilitate Federally authorized and constructed hurricane or shore protection structures damaged or destroyed by wind, wave, or water action of other than of an ordinary nature.

DWR is the State's liaison to the USACE for its emergency assistance under PL 84-99.

The USACE has three Districts within California: the Sacramento District, the San Francisco District, and the Los Angeles District. The Sacramento and San Francisco District both have jurisdiction over areas of the Delta. The USACE has responsibility over Federal levees and also has jurisdiction over the flood control operations of reservoirs having Federal flood control space. The USACE has made agreements with local Levee Maintaining Agencies (LMAs) to maintain Federal project levees. DWR personnel from the Flood Project Inspection Section conduct inspections to assess LMA maintenance of Federal levees and report to the USACE.

As stated above, the USACE provides Federal assistance under PL 84-99 when requirements for flood fighting exceed State and local resources. The Director of DWR or designee must approve any local request for PL 84-99 assistance. If the request meets USACE criteria, the USACE will assume management of the flood fight and all emergency repairs.

DWR and the USACE signed an updated Memorandum of Understanding (MOU) in 1999 to facilitate the working relationship and provide a better understanding of agency roles and responsibilities during a flood emergency. The 1999 MOU was organized in accordance with SEMS and included Standard Operating Procedures (SOPs) for responding to flood emergencies under PL 84-99. Through the USACE, DWR may request additional personnel, equipment, and supplies for flood fighting, rescue, and relief work. DWR anticipates requesting PL 84-99 assistance during a Delta levee failure disaster. Actions involving the USACE are described in the Response Action Summary Sheets in Appendix B.

United States Bureau of Reclamation (USBR)
USBR operates the CVP, which provides water throughout California for irrigation, water supply, hydropower, recreation, environmental needs, and flood control.

DWR and the USBR will coordinate the operations of SWP and CVP during catastrophic events. USBR projects may require changes in operations during an emergency as long as infrastructure is not jeopardized and their lawful function is not interrupted.

Federal Emergency Management Agency (FEMA)
The Federal government provides assistance during Presidentially declared emergencies and major disasters under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 93-288, as amended). FEMA is responsible for coordinating assistance with State and local governments under the Stafford Act. FEMA is also responsible for coordinating direct Federal assistance under the National

Response Plan (NRP). Under the NRP, Federal agencies such as the USACE may provide assistance with measures to reduce immediate threats to lives and property. OES is responsible for requesting Stafford Act assistance through coordination with FEMA; and all requests for Federal assistance by State and local agencies, including DWR, must be coordinated through OES.

NWS
The mission of the NWS is to provide river and flood forecasts and warnings for the protection of lives and property, and to provide basic hydrologic forecast information for the nation's environmental and economic well-being. Through the NWS, 10 weather forecast offices support California (the closest to the Delta is in Sacramento) and the California/Nevada River Forecast Center (CNRFC). The Sacramento Weather Forecast Office and CNRFC are co-located with the JOC. The Sacramento Weather Forecast Office provides weather, hydrologic and climate forecasts and warnings, and operates 24-hours a day on a year round basis. Working with DWR's DFM Hydrology Branch, the CNRFC issues joint river forecasts for main stem rivers throughout California. The forecasts are disseminated through NWS automated systems, the California Data Exchange Center, and the FOC. The CNRFC maintains usual business hours, but expands to 24-hour operations when emergency high water conditions exist or are anticipated.

The NWS and DWR signed a Joint Project Authority Agreement in April 1994. The NWS and the DFM Hydrology Branch combine their river forecasting and flood warning program in the FOC. From mid-October through April the joint team continuously monitors river stages and weather conditions to forecast potential high water stages. If river stages rise to threatening levels, the NWS and DWR issue joint forecasts as official public bulletins. In addition, the NWS and DWR provide forecasts to emergency managers, law enforcement, and government agencies in case action needs to be taken as part of their emergency action plans. When forecasts indicate an imminent threat of flooding, DWR contacts the appropriate Operational Area or appropriate OES REOC.

4.3.1.2 State Agencies

OES
OES is headquartered in Sacramento. For administrative purposes, OES has divided California into three geographic regions. Both the Coastal Region (in Oakland) and the Inland Region (in Sacramento) have responsibility for areas of the Delta, as shown in Figure 4-4. OES is the lead State agency for emergency management and is responsible for coordinating the State-level response to emergencies and disasters. In accordance with SEMS, OES provides support to the Operational Areas by facilitating mutual aid among local governments, mission-tasking State agencies to provide support, or requesting resources from the Federal government. During emergencies, OES activates the REOC in the affected Region, as well as the SOC at OES Headquarters in Sacramento. The REOCs are responsible for coordination with and support of the Operational Areas (OAs). During a flood emergency, OES assigns a liaison to the FOC.

CDF
CDF can provide personnel for flood fighting and levee patrols during an emergency and when events are anticipated from storm activity, high river stages, high tides, or large reservoir releases. CDF resources must be requested through OES; DWR may not order crews directly from CDF unless there is a reciprocal agreement between the two agencies.

In addition, CDF provides a majority of the crews used in flood fight activities and also assists OES by setting up mobilization centers, mobile kitchens, and other facilities. CDF's expertise in the ICS is a valuable resource during flood emergencies that can be extensively utilized to protect islands damaged in a Delta levee failure disaster and also to protect the islands that are at risk of being damaged after the event.

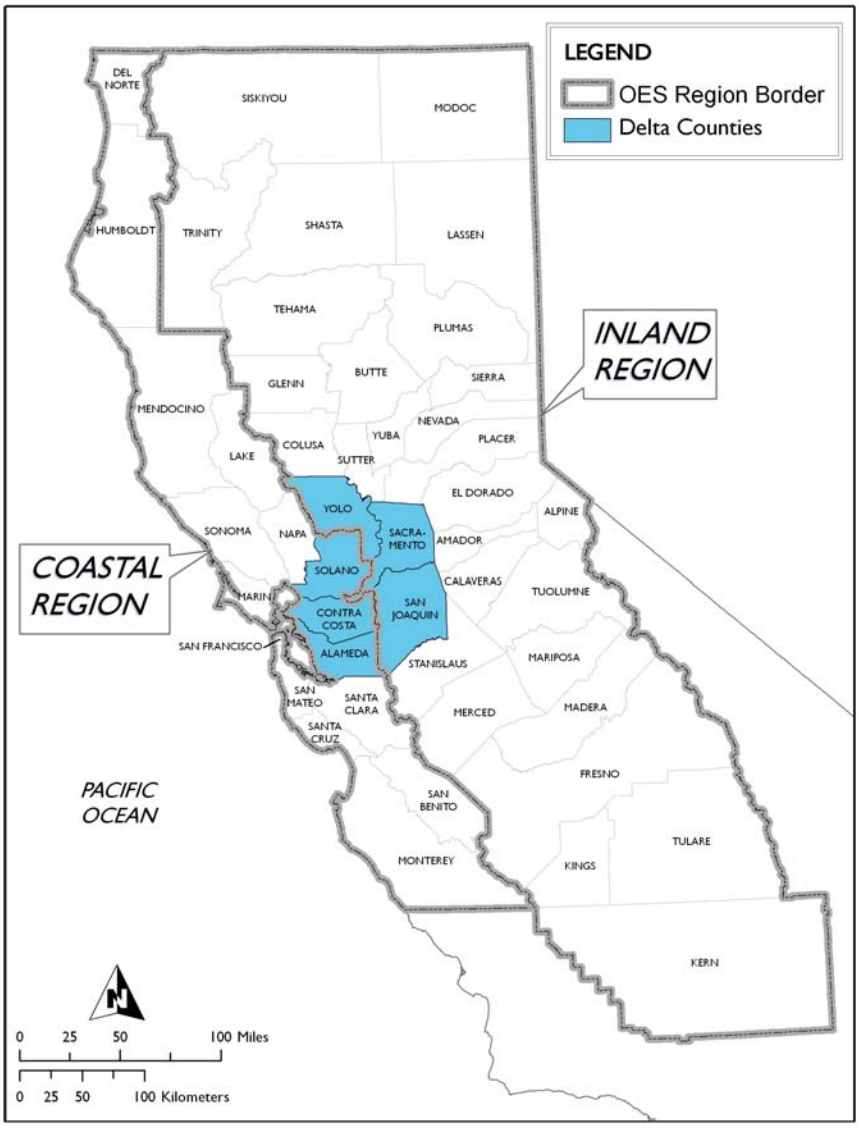


Figure 4-4 Delta Counties in the OES Coastal and Inland Regions

Source: URS, 2007.

California Conservation Corps (CCC)

The role of the CCC is similar to that of CDF. The CCC also provides personnel for flood fighting and levee patrols during emergency situations or when events are anticipated. Standby crews are frequently stationed near sites where problems are anticipated due to storm activity, high river stages, high tides, or heavy reservoir releases. During a Delta-wide emergency, it is anticipated that these crews will be immediately tasked with repair and restoration work.

4.3.1.3 Local Agencies

DWR cooperates with a number of local agencies during flood emergencies. DWR may provide technical assistance directly to local agencies on how to establish levee patrols, establish flood fight operations, investigate flood incidents, and coordinate requests for emergency assistance. DWR will also provide personnel and resources for flood fighting efforts to local agencies. The following are some core local partners that DWR will coordinate with during a Delta flood emergency.

LMAs
Local districts, counties, cities, and other public agencies have been delegated the responsibility to maintain and operate the flood works of the Sacramento River Flood Control Project, the San Joaquin River Flood Control Systems, and other Federal projects within local entity boundaries per Sections 8370 and 12642 of the CWC. LMAs have primary responsibility for levee maintenance and flood fighting and are responsible for patrolling and protecting levees during high water. In most instances, the LMAs are levee and reclamation districts, but also include other special districts, local government agencies, and private levee owners. The reclamation districts within the Delta are identified in Appendix C.

When the resources (personnel, equipment, materials, and finances) of an LMA are exhausted, the LMA may request assistance through the Operational Area.

OA
Under SEMS, an OA consists of the county and cities, special districts, and other public agencies within the county's geographical boundary. Again, as shown in Figure 4-4, the OAs that fall within the Delta region are Solano County, San Joaquin County, Yolo County, Sacramento County, Contra Costa County, and Alameda County. Coordination between cities and other public agencies within the OAs occur at the OA EOC. LMAs and other local government entities may request assistance through the OA EOC if they anticipate or are experiencing a shortfall in resources necessary for a response. The OA coordinates the provision of resources to meet these requests. When resources within the OA are exhausted, the OA EOC requests resources through mutual aid channels and the OES REOC.

All requests to DWR for PL-84-99 assistance and requests to OES for Federal assistance under a Presidential declaration of emergency or disaster must be submitted through the OA.

4.3.2 Other Stakeholders

This section includes other partners and stakeholders that DWR may also coordinate with, but are not considered core partners because there are no existing agreements or their coordination is not explicitly identified in the SEMS structure.

4.3.2.1 Federal Agencies

USGS
USGS coordinates with the NWS and DWR by providing stream flow data collected from telemetered gauges throughout California. USGS, during a flood emergency, will collect flow measurements and make repairs to damaged equipment at their gauging stations.

United States Coast Guard (USCG)
The USCG has jurisdiction in coastal waterways and has the authority to restrict commercial vessel traffic. The USCG will coordinate advisories and restrictions through OES during proclaimed emergencies. The USCG is also the lead Federal agency responsible for hazardous materials incidents

within coastal waterways. The USCG Pacific Strike Team, based in Alameda, has teams that maintain equipment pertinent to Delta emergency response, such as an assortment of boats, booms, pumps, skimmers, generators, lighting, air monitoring equipment, and other miscellaneous response equipment.

Western Area Power Administration (WAPA)
WAPA administers hydroelectric power and related services to transmit electricity from multi-use water projects. WAPA's transmission system carries electricity from 57 power plants operated by USBR, the USACE, and the International Boundary and Water Commission.

4.3.2.2 State Agencies

California National Guard (CNG)
CNG is a reserve force for the national armed forces and can provide emergency manpower, equipment, and transportation resources during emergencies.

California Highway Patrol (CHP)
CHP, along with local law enforcement, will provide traffic control and communication resources during flood emergencies.

California Department of Transportation (Caltrans)
Caltrans assesses the conditions of highways, local roads, State bridges, potential road restrictions or closures, and will estimate the time required for repair. If necessary, they establish alternate routes in coordination with the CHP.

4.3.2.3 Water Agencies

The agencies that draw water from the Delta would be affected by a Delta levee failure disaster and decisions to alter water supply operations.

EBMUD
EBMUD holds water rights to divert up to 325 million gallons per day from the Mokelumne River at Pardee Reservoir and uses this water in portions to Alameda and Contra Costa counties for municipal and industrial purposes.

CCWD
CCWD provides water to a population of 500,000 in Central and East Contra Costa County. CCWD diverts water into the Contra Costa Canal from Rock Slough in the southwestern Delta.

State Water Contractors
Through the SWP, DWR provides water to contractors in central and southern California, such as the Metropolitan Water District.

4.3.2.4 Private Entities and Non-Governmental Organizations

Private entities that own and operate infrastructure, such as the Pacific Gas & Electric Company (PG&E) and the Union Pacific Railroad, may take action to protect their assets during a Delta levee failure disaster or may alter their operations to avoid the Delta area. These entities, as well as environmental organizations, may also have an interest in decisions made during recovery.

Disaster assistance organizations, such as the American Red Cross and the Salvation Army, may assist local governments in housing, feeding, and evacuating people in flooded or flood-threatened areas.

5.0 DWR's Current Ability to Plan For and Respond to Delta Events

As stated in Section 1, DWR has broad authority to participate in flood emergency response. DWR is committed to preventing loss of life, reducing property damage, and protecting water quality and water supply when floods occur. One objective of DWR's role in flood response is to safeguard life and property, which includes assisting in response efforts, providing runoff forecasts, and supervising the design, construction, operation, and maintenance of flood control structures. DWR's second objective is to reduce the risk to water supply, most likely due to salinity intrusion into the Delta. However, water supplies can also be impaired by damage to infrastructure. Actions that can minimize or prevent risks to water supply include release of flushing flows from upstream reservoirs, installing barriers to block saltwater intrusion, decreasing exports, and establishing isolated paths for freshwater to flow to the south Delta.

As part of this concept paper, DWR conducted a document discovery process to catalog existing plans and procedures, in order to identify emergency response actions that have already been developed through other planning efforts. This discovery process was conducted to determine available options for response if an emergency in the Delta occurred; and to provide a framework for the development of a comprehensive EOP. The response actions identified through this process are listed in Table D-1 in Appendix D. A more detailed description of each action is provided on a corresponding summary sheet in Appendix E. Together, the table and summary sheets provide decision makers with a list of options that can be implemented when responding to an emergency and specific considerations related to each option.

The summary sheets address three types of actions:

- General and life safety;
- Flood fighting; and
- Water supply/water quality.

To facilitate use of the summary sheets, these actions have been organized according to the time frame in which they would be implemented, as follows:

Immediate Response Actions – actions that would occur during the first day.

Short-Term Response Actions – actions that are not immediate in nature and may occur up to five days after the event.

Mid-Term Response Actions – actions that are not immediate in nature and may occur up to 14 days after the event.

Long-Term Response Actions – actions that are not immediate in nature and may occur after 15 or more days.

Future Recommended Response Actions – actions that have been identified as recommendations for further evaluation and potential future inclusion into the EOP.

Table D-1, in Appendix D, lists the response actions identified during the document discovery process. The actions identified in Table D-1 are expanded upon in Appendix E, through the use of action summary sheets. Each action identified in Table D-1 has a corresponding summary sheet that provides greater detail

for the particular action. The purpose of the summary sheet is to build a collection of easy to understand options in order to quickly aid decision makers responding to an emergency.

The table and summary sheets are numbered for convenience; general and life safety actions are identified as GS, flood fight actions are identified as FF, and water supply/water quality actions are identified as WS. For example, the first immediate, general and life safety response action identified in Table D-1 would be GS-I-1.

The response actions identified may not equally impact all areas of the Delta. For convenience, the Delta itself has been subdivided into north, central, south, and west sub-regions, as different types of actions will result in significantly different regional responses based upon the physical characteristics of these regions. Table D-1 and the summary sheets use a graphic to represent the Delta regions (north, west, central, and south) and use shading (white, gray, and black) to represent the effectiveness of a particular response action in that region of the Delta. If an action is believed to be effective then that region's block is solid black. If an action is believed to have little or no impact, then the block is white. Actions that may have incidental or minor impacts on a region are shaded gray.

An example for two possible north of the Delta response actions include increasing upstream reservoir releases and curtailing diversions off the Sacramento River. It is known that simply releasing more Sacramento Valley water upstream of the Delta will improve water quality in the North and Western Delta regions. However, Sacramento Valley water has little effect on reducing salinity in portions of the South Delta (as illustrated in the 2005 State Water Resources Control Board [SWRCB] Cease and Desist Hearings), whereas curtailing diversions off the Sacramento River will impact water quality in the North Delta and have some impact on the Central Delta. The schematics on Figure 5-1 illustrate these two response actions.

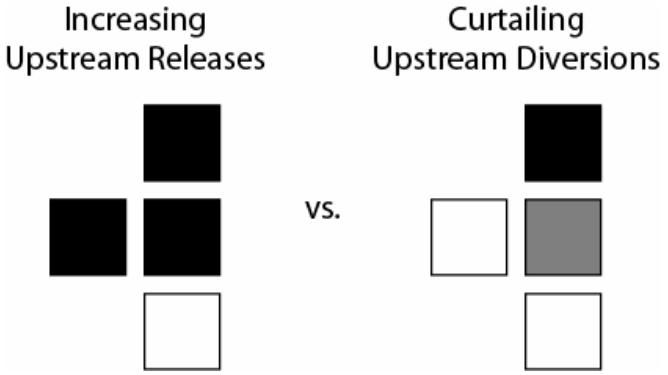


Figure 5-1 Graphical Representation of Response Action Impact in the Delta Regions

Source: DWR, 2007.

For illustrative purposes, the remainder of this chapter will discuss an abbreviated timeline of potential response actions during a levee failure event based on the DRMS scenario. As stated in Section 3.3, the DRMS scenario involves a seismically driven, multi-levee failure during the late summer impacting 20 islands. The locations most likely to be affected by an earthquake are the western and southwestern portions of the Delta, which are closer to potential earthquake sources and are therefore more likely to experience more intense shaking. Flooding of these islands is also more likely to interfere with fresh water conveyance to export pumps. Utilizing the organizational method for the response action summary sheets in Appendix E, the timeline is organized by general and life safety; flood fight and levee repair;

water supply and water quality operations; and immediate, short-term, mid-term, and long-term response actions.

Following a seismic event resulting in multiple levee failures in the western and southwestern Delta, the following actions are planned and will occur unless circumstances warrant modifications:

a. **Immediate Response Actions** – Immediate response actions are those conducted from the onset of an emergency and are focused on coordination, assessment and mobilization, providing for life safety and minimizing damage to property and infrastructure as quickly as possible. These actions occur during Day 1.

    i. *General and Life Safety* – Immediate, general and life safety actions to occur will include:

        1. Activation and mobilization of the DWR emergency management structure, FOC, and Delta Area Command Center (GS-I-1 – 4).

        2. Coordinate and report response efforts with other agencies, the media, and the public (GS-I-5. GS-I-7 – 8, GS-I-10 – 12).

        3. Conduct preliminary damage assessments (GS-I-6 and GS-I-9).

    ii. *Flood Fight and Levee Repair* – Immediate, flood fight and levee repair actions to occur will include:

        1. Prioritize efforts, re-task personnel, and mobilize contractors (FF-I-1 – 3).

        2. Utilize stored equipment and existing agreements/programs (FF-I-3 – 6).

    iii. *Water Supply and Water Quality Operations* – Immediate, water supply and water quality operational actions to occur will include:

        1. Conduct short-term modeling (WS-I-15 – 17).

        2. Decrease or halt exports or diversions (WS-I-1 – 3, WS-I-7 – 8, WS-I-11, WS-I-14).

        3. Increase flushing flows through the Delta (WS-I-5 – 6, WS-I-12 – 13, WS-I-18).

        4. Enhance pathways for freshwater flow to the South Delta (WS-I-4).

        5. Assess damage to infrastructure (WS-I-9 – 10).

b. **Short-Term Response Actions –** Short-term response actions are those conducted from Day 1 through Day 5.

    i. *General and Life Safety* – Short-term, general and life safety actions to occur will include:

        1. Conduct further damage assessments (GS-S-1).

    ii. *Flood Fight and Levee Repair* – Short-term, flood fight and levee repair actions to occur will include:

        1. Conduct short-term repairs and armoring (plastic, sandbags, and riprap) on weakened levees to prevent failure (FF-S-1 – 4).

    iii. *Water Supply and Water Quality Operations* – Short-term, water supply and water quality operational actions to occur will include:

1. Conduct long-term modeling and strategize for longer term effort (WS-S-1 – 3).
2. Increase flushing flows through the Delta, as warranted (WS-S-4, WS-S-7).
3. Decrease or halt exports or diversions (WS-S-5 – 6).

c. **Mid-Term Response Actions (Day 6 through 14) –** Mid-term response actions are those actions that are conducted from Day 6 through Day 14.

i. *General and Life Safety* – Mid-term, general and life safety actions to occur will include:

1. Governor relaxing existing standards to expedite response (GS-M-1).
2. Restoration of lifelines (i.e., power) (GS-M-2).

ii. *Flood Fight and Levee Repair* – Mid-term, flood fight and levee repair actions to occur will include:

1. Protect levees from wave erosion (FF-M-1).
2. Armor levee breach edges to prevent widening (FF-M-2).

iii. *Water Supply and Water Quality Operations* – Mid-term, water supply and water quality operational actions to occur will include:

1. Install temporary barriers to inhibit saltwater dispersion and facilitate flushing (WS-M-1 – 4).

d. **Long-Term Response Actions (Day 15 and on) –** Long-term response actions are those actions that are conducted from Day 15 on.

i. *General and Life Safety* – Long-term, general and life safety actions to occur will include:

1. Choose which islands to recover and in what order (GS-L-1).

ii. *Flood Fight and Levee Repair* – Long-term, flood fight and levee repair actions to occur will include:

1. Close levee breeches, as determined per GS-L-1 based on the Interim Levee Repair Policy (FF-L-1 – 2).

iii. *Water Supply and Water Quality Operations* – Long-term, water supply and water quality operational actions to occur will include:

1. Adjust long-term modeling and strategy (WS-L-1).
2. Remove temporary barriers, when warranted (WS-L-3).
3. Repair or re-operate water supply infrastructure (WS-L-2, WS-L-7).
4. Construct new infrastructure to deliver water, if necessary (WS-L-4 – 6).
5. Open closed waterways (WS-L-8).

6.0 Recommendations

Review of existing DWR emergency response procedures and documents has revealed an extensive group of available actions that can be drawn upon in the event of a Delta levee failure disaster. They provide a valuable starting point for DWR to address a major Delta event. However, the process has also resulted in the identification of areas where preparedness capabilities can be improved. This section presents recommendations for improving capabilities identified through the concept paper process. The recommendations are presented in several categories that generally increase in degrees of difficulty and expense. Appendix F provides summary sheets for potential response actions for future implementation.

As described in Section 1, the concept paper is the first phase of a process to develop a comprehensive EOP. The EOP process will result in the identification of gaps and areas for improvement described in Section 7. The recommendations described in this section may be included in, or expanded upon, during the EOP development process. Alternatively, they provide opportunities for further development and inclusion in future versions of the EOP.

6.1 Preparedness and Response Actions for Immediate Evaluation and Inclusion in the EOP

Many of the response actions identified in the appendices need to be further developed and detailed so they will be implemented smoothly and at the most opportune time during a real emergency, but essentially, all can be included in the initial version of the EOP.

6.1.1 SOPs and Training

Each response action identified in the appendix summary sheets will benefit from the presentation of additional information that gives specific details on the expected action and that assigns responsibilities to particular offices and personnel positions and (where helpful) provides substantive criteria, guidelines or even just examples of what considerations are relevant and what possibilities may present themselves. Often, these can take the form of an explicit SOP. To the extent these actions and procedures draw on information that already exists (for example, in more general flood operations), those relationships should be recognized. When special considerations or actions are pertinent to a low-Delta-inflow, multi-island flooding event, they need to be explained in detail.

In the case of a major Delta event, existing SOPs for flood operations might be assigned to other or additional personnel. Unique response actions pertinent to this type of event will usually be new to everyone. Thus, once procedures are developed for the type of emergency being considered here, it is important to follow up with training for all of the relevant management and operating personnel. Such training needs to be scheduled for routine repetition to reinforce memories and train new hires/replacement personnel on what is expected in this rare occurrence and to provide the needed exposure for employees who are new to their positions.

6.1.2 Supplemental Analyses to Provide Information Resources for Emergency Decisions

Some response actions require substantial analysis and design, in addition to the documentation and training described above. Examples include the following:

- **Upstream Reservoir Release Rates and Timing Need to be Reanalyzed –** The actions, as presently stated in Appendix D and E, specify a particular rate of supplemental release from each of the following four upstream reservoirs–New Melones, Folsom, Oroville, and Shasta. These rates are taken from DWR's 1986 Delta Emergency Water Plan. Unfortunately, there has not been recent

analysis by DWR and USBR to consider whether those release rates are still appropriate. And (to our present knowledge) water operators have not participated in substantive training exercises to practice emergency release decision making pertinent to a major Delta incident. SOPs could also be developed to aid decision making for water operators on how to proceed with release determinations. It has been indicated to the DRMS study team that supplemental releases will not be available from New Melones. That is the only project source now being considered to supplement San Joaquin River inflow; supplementing the San Joaquin flow is extremely important for the south Delta. Furthermore, none of the supplemental release rates from DWR's 1986 Emergency Plan consider what type of water year is occurring (or what amount of water is stored in the reservoirs). As a result, operators indicated to DRMS personnel that they would not order releases immediately. They would analyze the emergency first and begin supplemental releases after 2 or 3 days of analysis and consultation with their management. This would miss a prime opportunity for supplemental releases to be beneficial–during island flooding when supplemental inflow could prevent the drawn down Delta channels (upstream from the breaches) from being refilled by saline water. As part of the development work for the proposed DWR EOP, these release rates and their timing, should be reanalyzed and a table of immediate release rates should be developed for each reservoir with different rates based on month of the year and available storage.

- **Several Examples of Overall Water Operations Strategies Based on Different Situations (for DWR's Emergency Water Operations Team) –** DWR's 1986 Emergency Plan identified four different situations and outlined response elements for each. Only one addresses a low-Delta-inflow, multi-island flooding event. None of these examples has had the benefit of today's improved modeling capabilities to calculate consequences, or the critical examination of efforts and resources required or potential limitations that might prevent the indicated actions. Several scenarios need to be developed (just for low-inflow, multiple-island flooding events) in enough detail to understand whether their constituent actions are feasible for implementation in the assumed emergency, or what circumstances, such as quantities of upstream storage, are necessary for them to be feasible. Furthermore, even if they can be implemented, they should be analyzed to see whether they achieve the intended results in that emergency. Each scenario should then be documented as an *Overall Incident Water Management Response Strategy* that can be part of a library of available examples for incident water managers to use when they are faced with an actual emergency. Preparing and documenting such a scenario offers an excellent training opportunity. The personnel who will be assigned emergency water operation duties could participate in a workshop where the assignment is to develop a strategy for a specific scenario event. Their product can be analyzed, refined, documented, and it can then be one of the examples in the library. This provides a low-cost way to learn by experience and the luxury of allowing learning from mistakes without undesirable consequences.

- **Temporary Barriers for New Locations Need Preliminary Designs –** Temporary barriers are indicated as available response actions in DWR's 1986 Emergency Plan and are now being discussed by others (e.g., Ref. 3). At the present time, moveable and/or sinkable structures, such as some of those being discussed, are not available. Mention is made of possibly using sinkable and refloatable rock barges to form temporary barriers. Existing rock barges that might be dedicated to that purpose are scarce. Also, the process of sinking a barge is not as simple as it may sound. It is unlikely to achieve flow diversion because of barge dimensions and the existing geometric properties of the Delta channels. They would also be needed for levee repairs in a major Delta incident. Thus, for the present, it is assumed that any temporary barrier will consist mainly of rock berms in the water, transported and placed by marine equipment. The rock berm may be supplemented by imbedded pipes with flap gates to enable tidal pumping, similar to those now installed in the south Delta. For example, DWR's 1986 Emergency Plan suggests temporary barriers in Steamboat Slough and in the Sacramento River immediately downstream of Georgiana Slough to facilitate greater diversions

through the Delta Cross Channel and Georgiana Slough into the central Delta. It also mentions a rock barrier with tidal pumping capability on the San Joaquin River upstream of Rough and Ready Island. It suggests advance design studies for both of these concepts; to our knowledge, such advance designs are not currently available at these locations. These and other potential temporary barriers should be predesigned and evaluated for hydraulic effectiveness, constructability, resource requirements, and schedule. These design studies should be carefully documented so barrier applicability and effectiveness are clearly summarized. The documents should be included in the library available to incident water managers for use in defining their water management response.

There are undoubtedly other response actions that require further analysis. Such analyses should be planned and conducted as part of DWR's effort to create an effective EOP for a low-Delta-inflow, multi-island flooding event.

6.1.3 Easily Implemented Response Items That Deserve Definition and Evaluation

In addition, readily available, but not yet described or reviewed response actions will be identified. If they can be implemented without major modifications to existing facilities or new facilities, they should be defined and evaluated for inclusion in the initial version of the EOP.

One such item is identified in Appendix F. It would be possible to use a portion of the water stored in Clifton Court Forebay to repel salinity from the south Delta channels. No information was found to indicate that this response has been considered previously. The Clifton Court water is fresh and in position to be exported. The potential benefits would need to be evaluated before including it as a response action.

6.1.4 Minor Improvement of Facilities

The details developed on some response actions will lead to ideas for minor improvements to facilities. One example already identified is the capability of a portable generator to open the Delta Cross Channel gates if electric power is out. This and other minor improvements should be itemized, designed, and implemented as soon as possible, even if financial support has to be generated in expedited ways. They should be included in the initial version of the EOP.

6.2 Define Priorities for Emergency Levee Repairs

At this time, it is not clear what priorities DWR would establish for island repair in a low-Delta-inflow, multi-island flooding event. The DRMS project is faced with this need to estimate consequences from various levee failure scenarios and repair sequences. Setting such priorities will require policy decisions that consider impacts and tradeoffs.

Factors that might be under consideration include population, life and property, infrastructure (such as aqueducts, water diversion facilities, roads and highways, railroads, agriculture, etc), and saltwater intrusion, among others. Islands might be grouped into several (three or four) groups with similar priority, or a more detailed prioritization could be developed. Alternatives to the concept of prioritizing island repairs include a containment first, repair second approach, which could be as simple as repairing non-flooded islands first, to limit further flooding, and completing the repairs in order of least damage first.

The intrusion of salinity and disruption of water exports is likely to be the impact of greatest relevance to repair priorities. Although hydrodynamic modelers can estimate priorities, no modeling has yet been done to compare different repair sequences for their relative success in expediting the resumption of exports.

Such modeling should be performed (and can be performed with the tools available from the DRMS or other work) as part of an effort to define repair priorities more logically.

DWR will be more successful in responding to an actual emergency if it articulates and analyzes factors that should be considered in setting priorities and begins to attach relative degrees of importance to these factors.

6.3 Future Operational Enhancements or Potential Response Actions

Based on the preliminary analysis presented in this concept paper, there are several opportunities to facilitate emergency response by initiating discussions and agreements or contracts with agencies, companies, or groups external to DWR. Ideas are also being formulated and advocated for larger scale emergency preparations (e.g., Ref. 3). DWR should evaluate these opportunities and select some for pursuit. They will take time for development and are not yet ready for inclusion in the EOP but can be added in future versions.

For example, an emergency preparedness action that could be immediately addressed is to develop a decontamination/exposure plan. Such a plan would focus on health risks that may be associated to DWR emergency response personnel and would identify health risks involved with the potential contamination of the Delta waters. (i.e., hazardous materials, infestation, etc.) The plan would formulate a set of operational procedures to follow for "boots on the ground," emergency response personnel. By outlining emergency response procedures for decontamination and exposure, DWR would mitigate any potential hazards and/or risks to its personnel. Basic, common sense provisions should be included, such as awareness of risks training, compliance with OSHA requirements, availability of shower facilities, and access to medical services. Also, identifying equipment necessary for decontamination would be essential to incorporate into this plan.

6.3.1 Advance Agreements/Contracts

From the response actions identified in the appendices, there are some with difficulties or limitations that provide obvious opportunities.

One example is opening the Delta Cross Channel gates on an emergency basis, in spite of water quality standards that require them to remain closed during some parts of the year. Just having the capability for immediate, emergency opening would enhance the effectiveness of salinity repulsion during island flooding by immediately directing more Sacramento River flow into the central Delta.

Another issue is the availability of New Melones water for emergency releases. USBR and individual irrigation districts holding water rights to New Melones water could make water available for emergency releases. Similar releases should be confirmed from other federal reservoirs, such as Folsom and Shasta. These are items that are too important to leave for resolution during the actual emergency.

Water availability from other reservoir owners, especially on the San Joaquin River and the eastern Delta tributaries, should be pursued (e.g., Comanche, New Don Pedro, Lake McClure). This would require arrangements with individual water districts such as EBMUD and various irrigation districts.

In addition, an agreement between DWR and USBR to shut down the last Tracy pump when requested during a multi-island, low-flow levee breach event would be an example of an advanced operational agreement between agencies. Criteria should be established so appropriate situations for shut down can be recognized.

Finally, the availability of needed contractors is important, especially marine contractors (such as Dutra). They have generally made themselves available when needed but this availability could be enhanced for a major event if arrangements were made in advance to have contractors anticipate major response efforts for an extraordinary incident. It is unlikely that contractors will be able to include emergency diversion clauses in their contracts with other customers. A declaration of an emergency and directive by the Governor would be required to facilitate the diversion of contractors' equipment, manpower, and resources from existing contracts.

6.3.2 Investments in Inventories, Equipment, or Facilities

Finally, the potential for substantial preparatory investments should be considered. This could be large movable structures that would serve as temporary barriers (see Ref. 3) or other substantial expenditures to facilitate an expedited response. Examples identified in document reviews to date include:

- Install bridge and gate structures so that gates can be closed in an emergency to form a temporary barrier;
- Install hinged gates or slide gate structures to use as rapid deployment temporary barriers;
- Install/deploy tethered barges at strategic locations (the concept of tethered barges requires further study and testing to determine its practicality and cost-effectiveness, compared with the more conventional gate structures);
- Prepare for rapid deployment of barriers along an east-west alignment of fortified levees in the south Delta (such as south of the Empire Cut alignment or north of the Santa Fe/SP Railroad alignment);
- Fortify levees in the south Delta along either side of Middle River and Victoria/North Canals with temporary (possibly rock) barriers in Connection Slough, Empire Cut, Railroad Cut, Woodward Canal, and Old River to create an isolated Middle River connection from the fresh water pool in the San Joaquin River to Clifton Court Forebay; and
- Widen the Delta Cross Channel gates (possibly in combination with a partial Sacramento River barrier).

Other preparatory investments, such as major stockpiling of rock and pre-investment in essential equipment that is now in short supply, have been mentioned, but need to be critically evaluated. If analysis results indicate this would be advantageous, it would undoubtedly be at the location of barge loading facilities and would influence siting and design of those facilities. Stockpiling is expected to benefit flood preparedness and levee repair work in addition to emergency efforts during a catastrophic event. However, stockpiling of rock may not lead to substantial benefits for the following reasons:

- The stockpile may be limited in size (possibly not enough to make a difference in a large emergency);
- Stockpiled rock may have to be loaded and transported to the repair site by the same equipment bringing in material from the quarries, thus limiting the time savings envisioned;
- Large stockpiles of rock located in the Delta may sink into the ground over time; and
- Stockpiled rock will need to be safeguarded and inventories maintained.

Pre-investment in equipment, such as rock barges and dump scows, is costly. The capital expenditure not only in the equipment but also in mooring facilities, and the continual costs associated with maintenance and dry-docking would be very high. These and other ideas should be subjected to screening analyses to

select promising items for more detailed consideration and potential development as future response actions.

Transfer facilities include the establishment, purchase, or lease of waterside berthing facilities to facilitate transshipment of quarry material to barges during levee failure repairs. Transfer facilities would lessen DWR's dependence on the San Rafael quarry and would allow quarry materials to be transported to strategic locations within and around the Delta for subsequent water transport to repair sites. Potential facility locations include Stockton, Sacramento, Clifton Court, Hood (already being used by Dutra), Rio Vista, Benicia/Martinez, and Crockett/Vallejo. Site selections would depend on the analysis of potential quarry sources to supply each site, site seismic vulnerability, types of material needed and available, restrictions or impacts associated with truck traffic, and potential constraints on marine traffic for barge access and loading. However, before this measure is further developed, coordination meetings should be held with the DWR Levee Emergency Repair Group, Metropolitan Water District (MWD), and the USACE, to coordinate potential facility locations for optimal use for all programs (emergency levee repairs and disaster preparedness). It is not clear whether major stockpiles of quarry material would be warranted in association with transfer facilities. Regardless of that, a small stockpile capability would be desirable to allow trucks to unload when a barge was not available and to finish loading a barge when truck arrival is delayed.

Before determining transfer facility locations, prequalification of quarries throughout California and a seismic vulnerability assessment of these locations would be recommended. During an event with the magnitude considered by DRMS, a significant amount of rock will be needed in an urgent time frame. The process of getting rock would be expedited if DWR had previously identified qualified quarries that had the rock producing capabilities and the desire to commit substantial service to DWR during emergencies. The types and gradations of rock desired and to be provided should be specified in advance in addition to inspection and quality control requirements. A quarry vulnerability assessment should be part of the qualification procedure. Assessment of each quarry's production capabilities and their estimated reserve of material should be made.

In addition, the stockpiling of non-quarry materials and tools should be evaluated. This recommendation would suggest that the LMAs stockpile the following items for every 5 miles of levee under the LMAs jurisdiction for flood fight activities:

- 10 rolls of visquine plastic (10 rolls at 100 feet x 20 feet x 10 millimeters);
- 5,000 sandbags;
- 8 boxes of twine at 200 pounds;
- 200 wooden stakes;
- 1,000 tie buttons;
- 8 lineman pliers;
- 8 sledge hammers;
- 10 shovels; and
- Life jackets for all potential personnel.

To supplement this, DWR would maintain storage boxes of similar equipment at eight strategic locations within and around the Delta. The quantities of these inventories and their management and upkeep could enhance pre-event preparations.

However, due to the low frequency of an event and the magnitude of the DRMS scenario, it would be difficult to stockpile this material for any significant amount of time and upkeep of the material could be very costly. Because the materials would be held in storage containers, the materials and equipment will be subject to elements such as high temperatures and humidity. These factors significantly decrease shelf life. A potential measure would be to build or lease permanent, climate controlled storage facilities. The equipment storage facilities could be co-located with the transfer/dock facilities, as discussed above in this section. Before the construction of permanent DWR warehouse facilities, existing warehouses in the Delta near strategic locations could be leased or rented for materials storage.

6.4 Preparedness and Response Actions Ready for Immediate Implementation During Development of the EOP

Review of the recommended emergency response actions or measures has revealed extensive future possibilities. Some actions have demonstrated less degrees of difficulty for near-immediate implementation. Table 6-1 identifies actions that can best accomplish this. The actions include physical, operational, and/or legal measures DWR can implement in the near term to help prepare the Department, LMAs, and other water agencies in the event of catastrophic levee failures. The analysis of future response and preparedness actions indicates these measures to be the best candidates for near-term implementation, based on need for action, flood preparedness enhancement, potential usefulness to other ongoing efforts (emergency levee repairs), and durability of measure (can this measure maintain usefulness if an event does not happen for several years).

Table 6-1 Actions Ready for Immediate Implementation During Development of the EOP

Recommendations for Immediate Implementation	Example of Options/Considerations
• **Transfer Facilities**	Identify existing dock space to lease in strategic locations
• **Stockpile Quarry Material**	Identify vacant land to lease or purchase, near transfer facilities
• **Warehouses for Non-Quarry Material and Tools**	Rent existing climate controlled warehouses at strategic locations
• **Temporary Barriers**	Confirm effectiveness of temporary barriers on the Sacramento (including Steamboat and Sutter Sloughs) and San Joaquin Rivers and, if confirmed, prepare for emergency installation
• **Decontamination/Exposure Plan**	Make site implementation plans, define risks, prepare training information (include site logistics)
• **Analyses Needed**	— Quantify amount of upstream water available in various months and water years and identify when to release it for effective flushing — Establish the ER&R model (from DRMS) as an emergency management tool — Establish the WAM from DRMS as an emergency management tool — Develop a priority system for levee repair in multi-island flooding events — Develop examples of overall water management strategies for various multi-island flooding scenarios (occurring at various times and for various types of year)

Table 6-1 (Continued)

Recommendations for Immediate Implementation	Example of Options/Considerations
• **Small Facility Improvements**	— Delta Cross Channel (address loss of power operation) — Clifton Court Forebay (address loss of power operation)
• **Standard Operating Procedures**	— Pump shut down — Gate operations

DRMS = Delta Risk Management Strategy
EOP = Emergency Operations Plan
ER&R = Emergency Repair & Response
WAM = Water Analysis Module

7.0 Next Steps

This section describes the proposed approach to continued development of the EOP and enhancements to DWR's response capabilities.

7.1 Development of the EOP

A comprehensive EOP would have the following benefits:

- Clarification of roles and responsibilities for preparedness, response, and recovery within DWR;
- Strengthening of partnerships with OES, OA lead agencies and other local government entities, Federal agencies, and others in the context of the response to a disaster in the Delta;
- Clarification of DWR's role within SEMS, as it pertains to a disaster in the Delta;
- Better definition of actions beyond immediate efforts to save lives and protect property, such as measures to protect and stabilize the water supply, and the coordination of these actions through SEMS; and
- Compliance with SEMS/NIMS, thereby ensuring consistency with national preparedness initiatives and enhancing cooperation with Federal agencies.

The approach to developing a comprehensive EOP is outlined below.

Identify and convene discussions with key stakeholders. Depending on the magnitude and extent of the event, DWR will be part of the larger response by all levels of government and the private sector and will be affected by competition for scarce resources due to competing priorities across the region. Therefore, the EOP must be consistent with the plans of other agencies and provide for coordination of priorities and resources. The process should involve DWR's partners in emergency management and the operation of the State's water supply system, as follows:

- Emergency management organizations, including OES and the five counties participating in the Delta Flood Response Group effort; other State agencies, such as the Caltrans; Federal agencies such as FEMA and the USACE; and private sector entities, such as PG&E, that have critical infrastructure in the Delta or who would be called upon to provide resources during a response.
- Water users, including State Water Contractors such as the Metropolitan Water District; agencies with water supply infrastructure in the Delta, such as EBMUD and the CCWD; and the USBR.
- Environmental agencies and interests, such as the California Department of Fish and Game (CDFG) and non-governmental organizations.

Develop failure scenarios and potential responses. DWR would use failure scenarios to develop potential response strategies. The scenarios would reflect a variety of circumstances requiring different responses (for example, two different scenarios might be an earthquake during the dry season and widespread levee failures during flooding in the rainy season). Potential response actions would be developed for each scenario.

Using the 20-island earthquake scenario and the emergency response priorities presented in this paper, DWR would develop an Initial Example Strategy. The response strategy would consider proposals developed by the Delta Flood Response Group and the Metropolitan Water District, as well as actions taken during DWR's 1976-77 drought emergency operations. To develop the strategy, DWR would:

- Use the actions described in this paper; the ER&R model, currently being developed under the DRMS project (described in Section 6); and input from stakeholders.
- Use assumptions, data (such as infrastructure and population information), modeling results, and other information from the DRMS project.
- Consider actions taken in all phases of the response (immediate, short-term, mid-term, and long-term), as described in Section 5.
- Conduct hydrodynamic and water quality analyses to test the effectiveness of the response strategy in reducing impacts to water quality and the environment.
- Develop additional response strategies based on input from stakeholders.

This process would allow DWR to test the applicability of its analytical tools, such as the ER&R model, for use in support of decision-making during a Delta levee failure disaster. Additionally, as part of this effort, DWR would identify potential gaps in resources and capabilities required for response.

DWR would also develop example strategies for response to other scenarios. Potential scenarios include:

- Earthquake-driven, multi-island, wet season event;
- Flood-driven, multi-island, wet-season event; and
- Alternative dry-season event involving different islands.

As with the Initial Example Strategy, DWR would develop response strategies for each scenario; test these strategies using hydrodynamic and water quality analyses; and identify potential gaps in resources and capabilities required for response.

The scenarios and responses to each would be included in the EOP as annexes.

Develop the EOP. Based on coordination with other stakeholders and development of the example strategies, DWR would prepare the EOP. The EOP would:

- Describe DWR's structure for responding to emergencies, roles and responsibilities of DWR and other agencies, implementation of the ICS, and policies and procedures that would be generally applicable in an emergency response.
- Focus on DWR's operations, but reflect DWR's relationships with other stakeholders and will facilitate cooperation with those stakeholders during events.
- Describe not only immediate, local actions to save lives and protect property, but also long-term actions to protect and stabilize the water supply throughout the State.
- Be consistent with SEMS and comply with NIMS.

Conduct training and exercises. Following completion of the draft EOP, DWR would provide training to familiarize staff and partner agencies with the plan. An exercise program would be implemented to evaluate the effectiveness of the EOP and to implement improvements. The program would consist of one or more tabletop exercises, followed by a functional exercise specifically designed to evaluate key components of the plan. To be most effective, these exercises would involve not only DWR but also other local, State, and Federal agencies that would participate in a response. Following completion of the exercise, lessons learned would be incorporated into the EOP to refine its effectiveness.

Identify gaps in capabilities. It is likely that a catastrophic levee failure event in the Delta would exceed local and State response capabilities. Through the development of the EOP and the exercise program, and in combination with the ongoing risk analysis being conducted under DRMS, DWR can refine its understanding of where gaps in the response capabilities exist, and work with its partners to identify potential recommendations for enhancing those capabilities and increasing the level of preparedness. Resources required for responses to the failure scenarios included in the EOP would be identified and compared to resources available within the region and the State. This analysis would enable DWR to identify areas where gaps potentially exist, requiring support from outside the region or from Federal agencies. In addition, Phase 2 (due to be completed in October 2007) of DRMS will result in an inventory of actions for reducing risks in the Delta. This inventory can also be used to identify gaps in response capabilities and proposed measures for closing those gaps.

7.2 Recommendations for Immediate and Expanded Capability Enhancements

DWR is already committed to several pre-event activities that will significantly enhance response capabilities for a Delta levee failure disaster. For example, DWR is developing real-time modeling tools that will provide analytical capabilities for decision makers during emergency response and to facilitate long-range planning during the recovery phase.

As described in Section 6, the process to develop this paper has also identified pre-event activities that can be undertaken now, as well as recommended activities that can be undertaken once DWR has had the opportunity to coordinate its actions with other parties. The process to develop the EOP, as well as the inventory of risk reduction actions currently being developed under Phase 2 of the DRMS project, will result in additional recommendations for enhancing response capabilities and reducing the risks associated with a Delta levee failure disaster. Examples of potential recommendations include:

- Actions to decrease response time, such as stockpiling material at key locations.
- Installation of physical measures to reduce impact, such as design of barriers or gates.
- Operational components, such as reservoir releases.

Preliminary costs, potential constraints (such as legal or environmental issues), and potential timelines for implementation would also be developed. The identified pre-event actions will be consistent with the EOP, as well as with the needs of the larger community outside DWR.

Throughout the process, DWR may select improvements for immediate implementation as they are identified, depending on the criticality, cost, and constraints associated with implementation.

7.3 Implementation Plan

DWR would prepare an implementation plan reflecting the costs, constraints, and potential timelines for proposed improvements described in Section 7.2. The plan would set annual goals for implementation during a five-year planning period based on identified priorities, current and projected funding, potential partnerships, and ongoing initiatives that could be leveraged to achieve desired results. The implementation plan would also provide for scheduled revisions to the EOP based on capability enhancements as recommended measures are implemented.

Although this plan is intended to guide the process for implementing identified improvements, DWR may select identified improvements for immediate implementation as warranted and described in Section 7.2.

7.4 Conduct Outreach and Ensure Public Awareness

As described in Section 7.1, participation of DWR's partners in emergency management and the operation of the State's water supply system will be crucial to the successful development and implementation of the EOP, as well as to the pursuit of recommended enhancements to capabilities. Additionally, the program must proceed in an environment of public, governmental, and legislative support that is built upon a clear understanding of the program's benefits. A multi-faceted approach, consisting of the following elements, would be implemented:

- Engage key partners in EOP development, training/exercises, and implementation.
- Engage key partners in the development of recommendations for enhancing capabilities and in development of the implementation plan.
- Develop a program for intergovernmental outreach to engage those local, State, Federal, and non-governmental agencies who are not directly involved in the EOP development but may play some role in response to a Delta disaster.
- Through the DWR Public Affairs Office, develop an outreach program communicating the benefits of the EOP program. Consider joint public information activities with local governments to advise the public on actions that should be taken to prepare for a Delta disaster.
- Develop legislative briefings for key points in the process–project initiation, completion of the EOP, and completion of the implementation plan.
- Engage key legislative affairs staff in the development of the implementation plan to identify potential vehicles for funding recommended actions.

7.5 Schedule

A tentative schedule for EOP development and associated actions is presented in Figure 7-1.

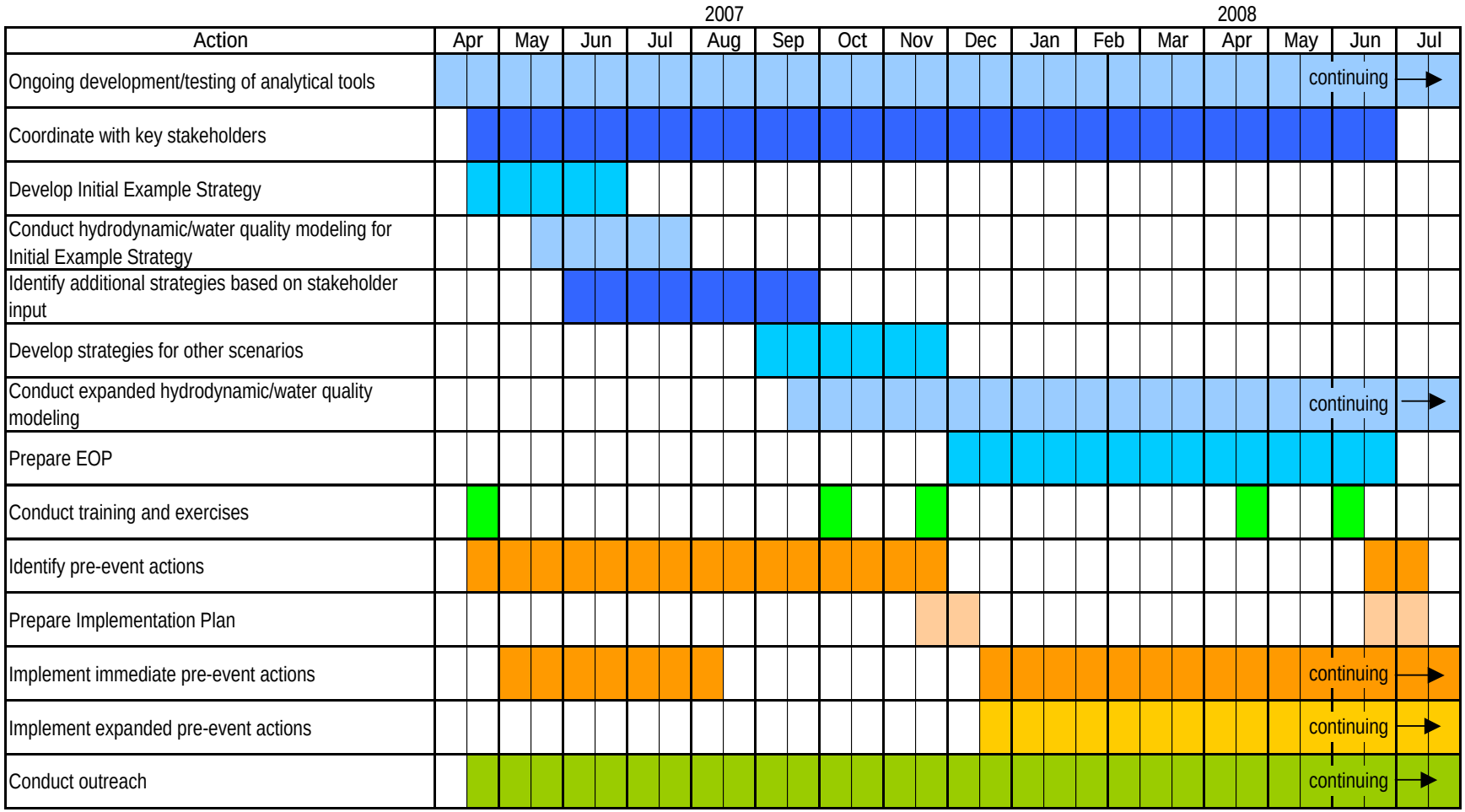


Figure 7-1 Tentative Schedule for Development of the EOP

Source: URS, 2007.

APPENDIX A

Island Volume Table

Potential Flood Volume of Islands within the Delta

ISLAND OR TRACT NAME	VOLUME [acre-foot]	YEAR OF SURVEY
Atlas Tract	21	1997
Bacon Island	66,933	1997
Bethel Island	13,006	1997
Bishop Tract	5,066	1997
Bouldin Island	81,092	1997
Bract Tract	29,332	1997
Bradford Island	15,297	1997
Brannan/Andrus Island	156,198	1997
Browns Island	2	1997
Byron Tract	20,578	1997
Canal Ranch	14,668	1997
Coney Island	4,183	1997
Dead Horse Island	875	1997
Decker Island	1	1997
Empire Tract	53,011	1997
Eucalyptus Island	1	1997
Fabian Tract	898	1997
French Island	0	1997
Grand Island	107,185	1997
Hastings Tract	759	1997
Holland Tract	30,770	1997
Ida Island	0	1997
Jersey Island	25,216	1997
Kimball Island	0	1997
King Island	28,820	1997
Liberty Island	0	1997
Little Mandeville Island	0	1997
Lower Jones Tract	57,152	1997
Mandeville Island	72,837	1997
McCormack-Williamson Tract	148	1997
McDonald Island	82,168	1997
Medford Island	11,526	1997
Merritt Island	50	1997
Moore Tract	43	1997
Moss Tract	188	1997
New Hope Tract	3,685	1997
Orwood Tract	15,245	1997

ISLAND OR TRACT NAME	VOLUME [acre-foot]	YEAR OF SURVEY
Other	26,548	1997
Palm Tract	20,182	1997
Pierson District	15,477	1997
Prospect Island	204	1997
Quimby Island	6,834	1997
Rindge Tract	78,354	1997
Rio Blanco	1,247	1997
Roberts Island	103,302	1997
Rough and Ready Island	428	1997
Ryer Island	57,012	1997
Sherman Island	95,610	1997
Shima Tract	2,537	1997
Shinkee Tract	1,395	1997
Staten Island	109,376	1997
Stewart Tract	1	1997
Sutter Island	2,442	1997
Terminous Tract	83,749	1997
Tinsley Island	0	1997
Twitchell Island	39,496	1997
Tyler Island	82,080	1997
Union Island	28,964	1997
Upper Jones Tract	39,646	1997
Veale Tract	2,919	1997
Venice Island	47,299	1997
Victoria Island	54,160	1997
Webb Tract	69,800	1997
West Island	1	1997
Woodward Island	17,392	1997
Wright-Elmwood Tract	10,062	1997

APPENDIX B

DRMS Maps

Data Compilation/ Asset Definition

GIS Data Compilation Facility Types/Quantity for each island

Infrastructure Attributes

Infrastructure Owner Input:
- Asset Definition
- Historical Costs of Repairs
- Time to Repair
- Revenue Losses

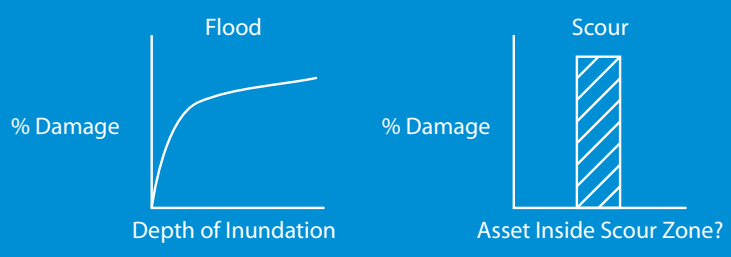
Repair/Replacement Costs Time to Repair Assets

Time to pump out islands from Emergency Response & Repair Group

Analysis/Evaluation

Infrastructure Damage Assessment

- Damage to Assets Inside Island Due to Levee Failure:
  —Flood
  —Scour
- Depth of Flooding to Assess Damage



Assess Uncertainty in Infrastructure Repair Cost Estimates

Summary Results of Analysis

Flood Damage to Assets Inside Island/Tract

Island	Asset Type	Inventory Unit	Quantity	Average Inundation Depth (ft)	Average Percent Damage	Unit Cost of Replacement ($000)	Expected Repair or Replacement Cost ($000)	Expected Time to Complete Repair (days)

Scour Damage to Assets Inside Island/Tract

Island	Starting Mile Location	Ending Mile Station	Levee Length (ft)	Asset Type within Land Scour Zone	Inventory Unit	Quantity	Percent Damage	Unit Cost of Replacement ($000)	Expected Repair or Replacement Cost ($000)	Expected Time to Complete Repair (days)

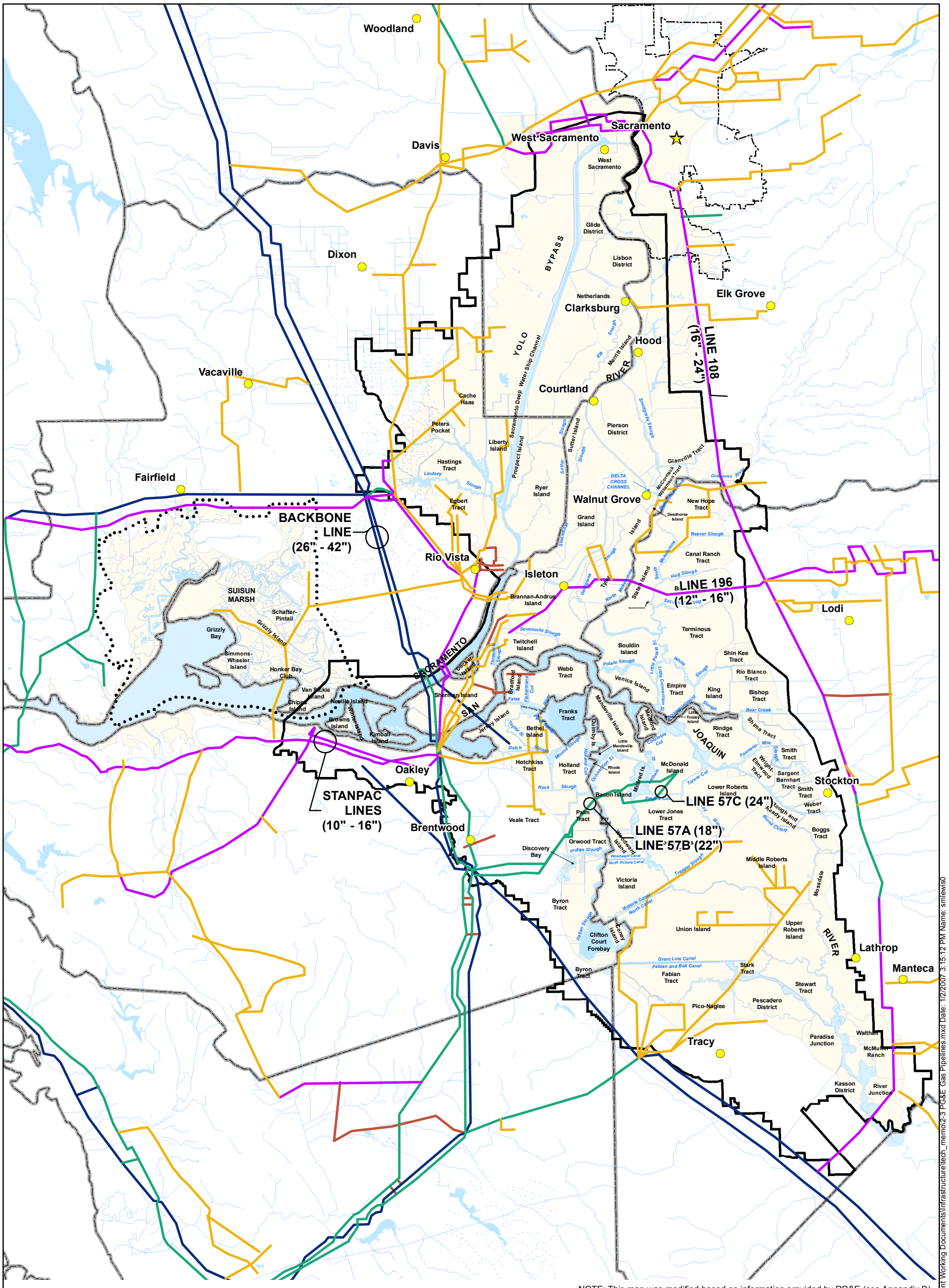
Summary of Results/ Tech Memo

Technical Memorandum

Economic Consequences Group

Risk Analysis Model

URS	DRMS 26815431	Delta Infrastructure Damage Assessment Potential—Work Flow Diagram	Figure 1-1



NOTE: This map was modified based on information provided by PG&E (see Appendix B).

Legend

PGE Natural Gas Pipelines
(Diameter in Inches)

- Unknown Diameter
- 2 - 12
- 13 - 17
- 18 - 24
- 25 - 42
- Intermittent canal, ditch, aqueduct, stream, river, or wash
- Perennial canal, ditch, or aqueduct; stream, river; reservoir
- CA Water
- CA Counties
- Legal Delta
- Suisun Marsh

0 5 10 Miles

URS	DRMS 26815431	PG&E Natural Gas Pipelines

Figure 2-2

Woodland
Davis
Sacramento
West Sacramento
West Sacramento
Glide District
Lisbon District
Dixon
BYPASS
Clarksburg
Netherlands
Elk Grove
YOLO
Water Ship Channel
Hood
Merritt Island
RIVER
Vacaville
Courtland
Cache Haas
Peters Pocket
Liberty Island
Sacramento Deep
Prospect Island
Sutter Island
Pierson District
Snodgrass Slough
Glanville Tract
Hastings Tract
Lindsey Slough
Fairfield
Egbert Tract
Ryer Island
DELTA CROSS CHANNEL
Walnut Grove
McCormack Williamson Tract
New Hope Tract
Deadhorse Island
Grand Island
Island
Beaver Slough
Canal Ranch Tract
Brack Tract
Sycamore Slough
Lodi
Rio Vista
Isleton
Brannan-Andrus Island
Terminous Tract
Twitchell Island
Bouldin Island
Shin Kee Tract
Rio Blanco Tract
SUISUN MARSH
Schafter-Pintail
Grizzly Island
Grizzly Bay
Simmons-Wheeler Island
Honker Bay Club
Webb Tract
Venice Island
Empire Tract
King Island
Bishop Tract
SACRAMENTO
Decker Island
Sherman Island
SAN
Bradford Island
Franks Tract
Mandeville Island
Medford Island
Rindge Tract
Shima Tract
Van Sickle Island
Chipps Island
Neville Island
Browns Island
Kimball Island
Jersey Island
Bethel Island
Holland Tract
Horchkiss Tract
Oakley
JOAQUIN
Columbia Cut
Smith Tract
Stockton
Sargent Barnhart Tract
Lower Roberts Island
Bacon Island
Palm Tract
Veale Tract
Brentwood
Lower Jones Tract
Weber Tract
Rough and Ready Island
Boggs Tract
Orwood Tract
Upper Jones Tract
Discovery Bay
Middle Roberts Island
Victoria Island
Byron Tract
Union Island
Upper Roberts Island
Mossdale
RIVER
Lathrop
Manteca
Clifton Court Forebay
Grant Line Canal
Fabian and Bell Canal
Fabian Tract
Stark Tract
Stewart Tract
Pico-Naglee
Pescadero District
Tracy
Paradise Junction
Waltham
McMurtrey Ranch
Kasson District
River Junction

Legend

- Substations
- US Cell Towers

Transmission Lines

- 230kV - 344kV
- 500kV - 734kV
- Below 230kV

- Intermittent canal, ditch, aqueduct, stream, river, or wash
- Perennial canal, ditch, or aqueduct; stream, river; reservoir
- CA Water

- CA Counties
- Legal Delta
- Suisun Marsh

0 5 10 Miles

URS

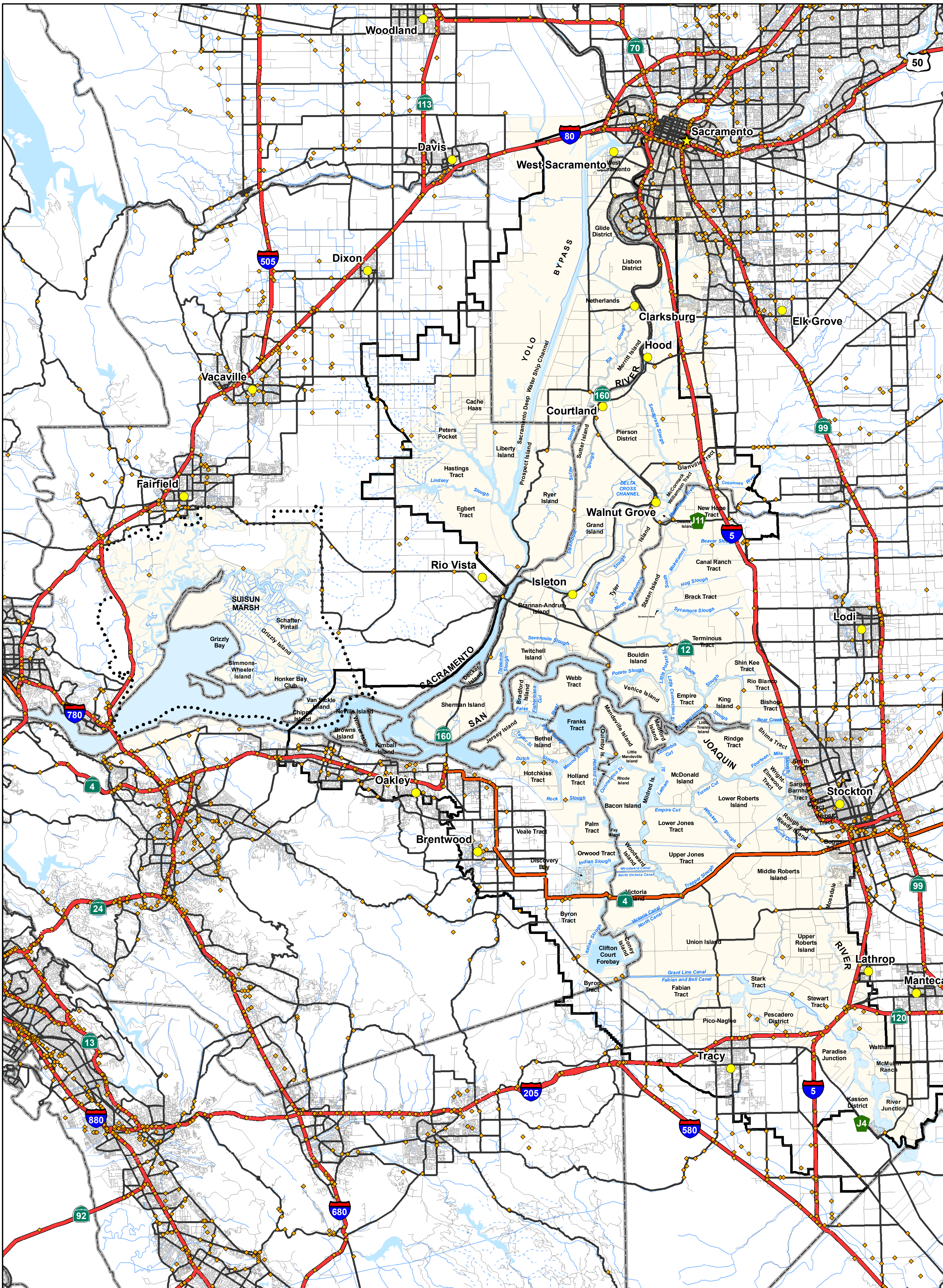
DRMS

26815431

Transmission Lines, Substations & Cell Towers

Figure 2-3

URS Corporation P:\GIS\GIS_Project_Files\MXD\Current Working Documents\Infrastructure\tech_memo_R1_010507\2-3 Transmission Lines, Substations & Cell Towers.mxd Date: 1/5/2007 9:10:23 AM Name: smlewis0



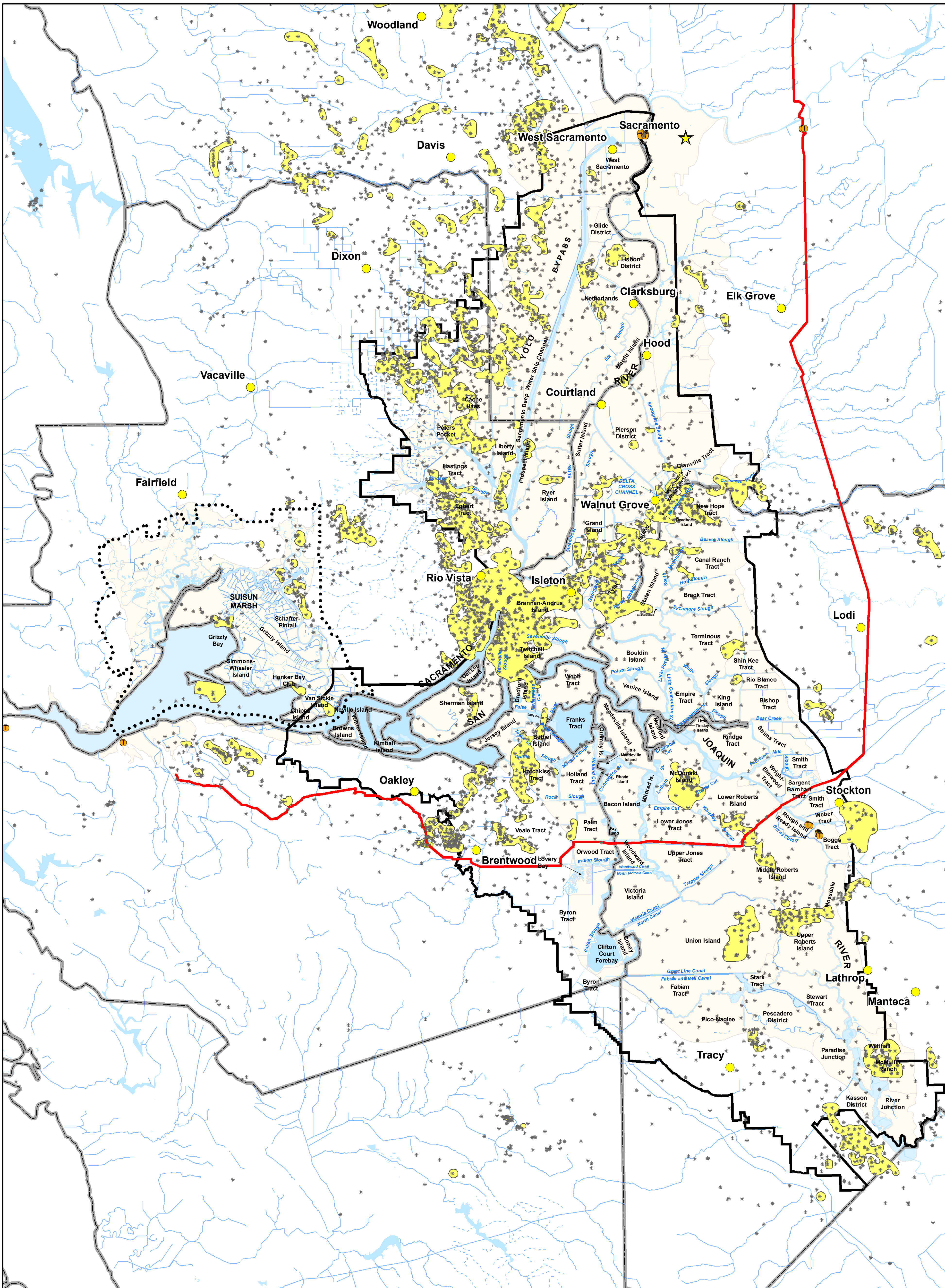
Legend

- Highway
- Major Road
- Local Road
- Bridges
- Intermittent canal, ditch, aqueduct, stream, river, or wash
- Perennial canal, ditch, or aqueduct; stream, river; reservoir
- CA Water
- CA Counties
- Legal Delta
- Suisun Marsh

0 5 10 Miles

URS	DRMS 26815431	Highways and Roads	Figure 2-4

URS Corporation P:\GIS\GIS_Project_Files\MXD\Current Working Documents\Infrastructure\tech_memo\2-7 Highways and Roads.mxd Date: 1/2/2007 11:02:54 AM Name: smlewis0



Legend

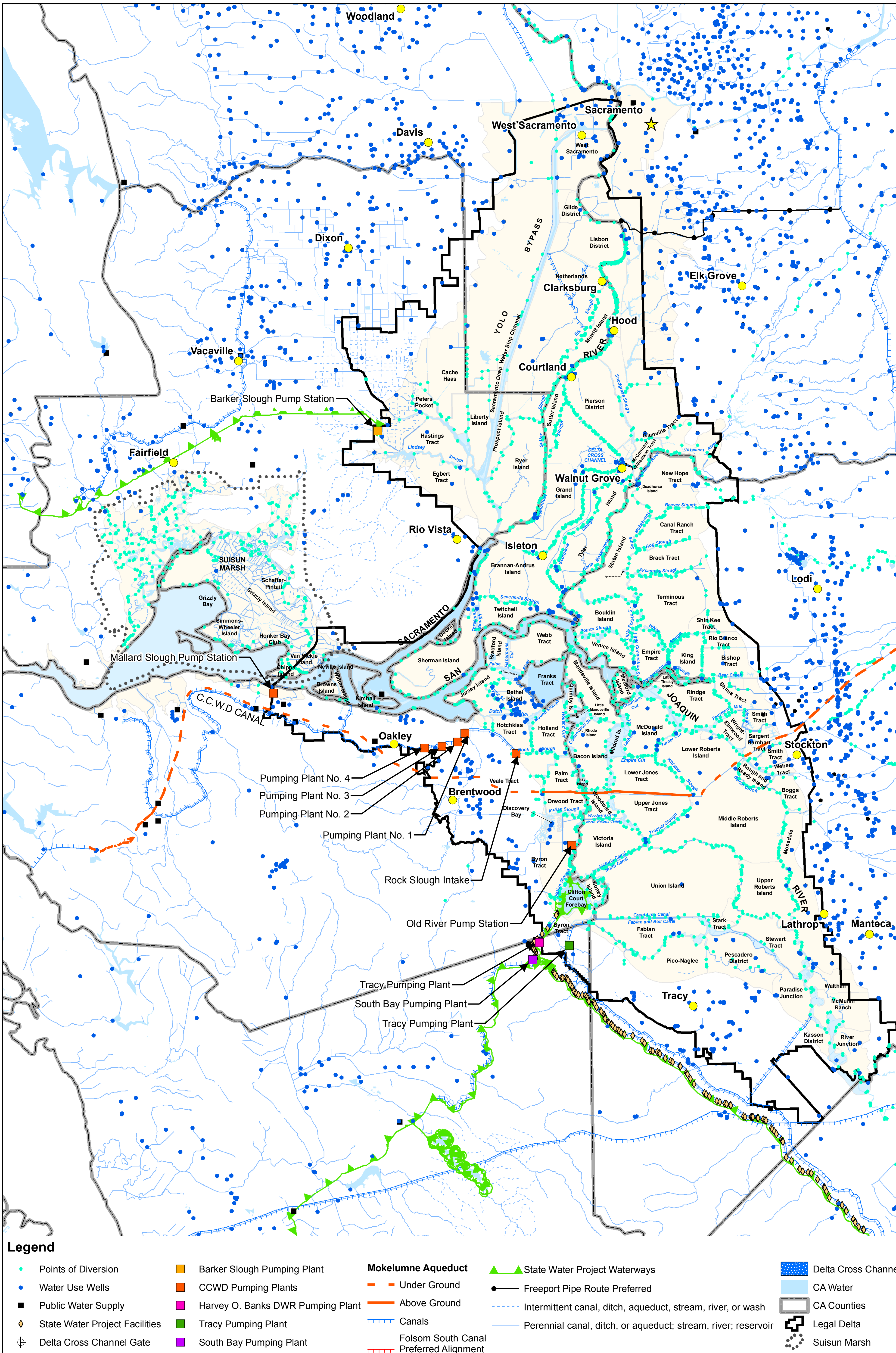
Tank Farm	Gas and Oil Well
Kinder Morgan Gas Pipeline LS9	Gas and Oil Production Field
Intermittent canal, ditch, aqueduct, stream, river, or wash	Perennial canal, ditch, or aqueduct; stream, river; reservoir
CA Water	
CA Counties	Legal Delta
Suisun Marsh	

0 5 10 Miles

N

URS	DRMS	Oil & Gas	Figure 2-5
	26815431		

URS Corporation P:\GIS\GIS_Project_Files\MXD\Current Working Documents\Infrastructure\tech_memo\2-8 Utilities_Oil_Gas.mxd Date: 1/2/2007 9:40:37 AM Name: smlewis0



URS	DRMS	Water Wells, Canals & Mokelumne Aqueduct	Figure 2-6
	26815431		

BNSF RR - Burlington - Northern Santa Fe Railroad
SPTC - Southern Pacific Transportation Company
UPRR - Union Pacific Railroad

Legend

- Railroads
- Highway
- Railroad Nodes
- Intermodal Terminal Facilities
- Intermittent canal, ditch, aqueduct, stream, river, or wash
- Perennial canal, ditch, or aqueduct; stream, river; reservoir
- CA Water
- CA Counties
- Legal Delta
- Suisun Marsh

0 5 10 Miles

URS

DRMS

26815431

Railroads

Figure 2-7

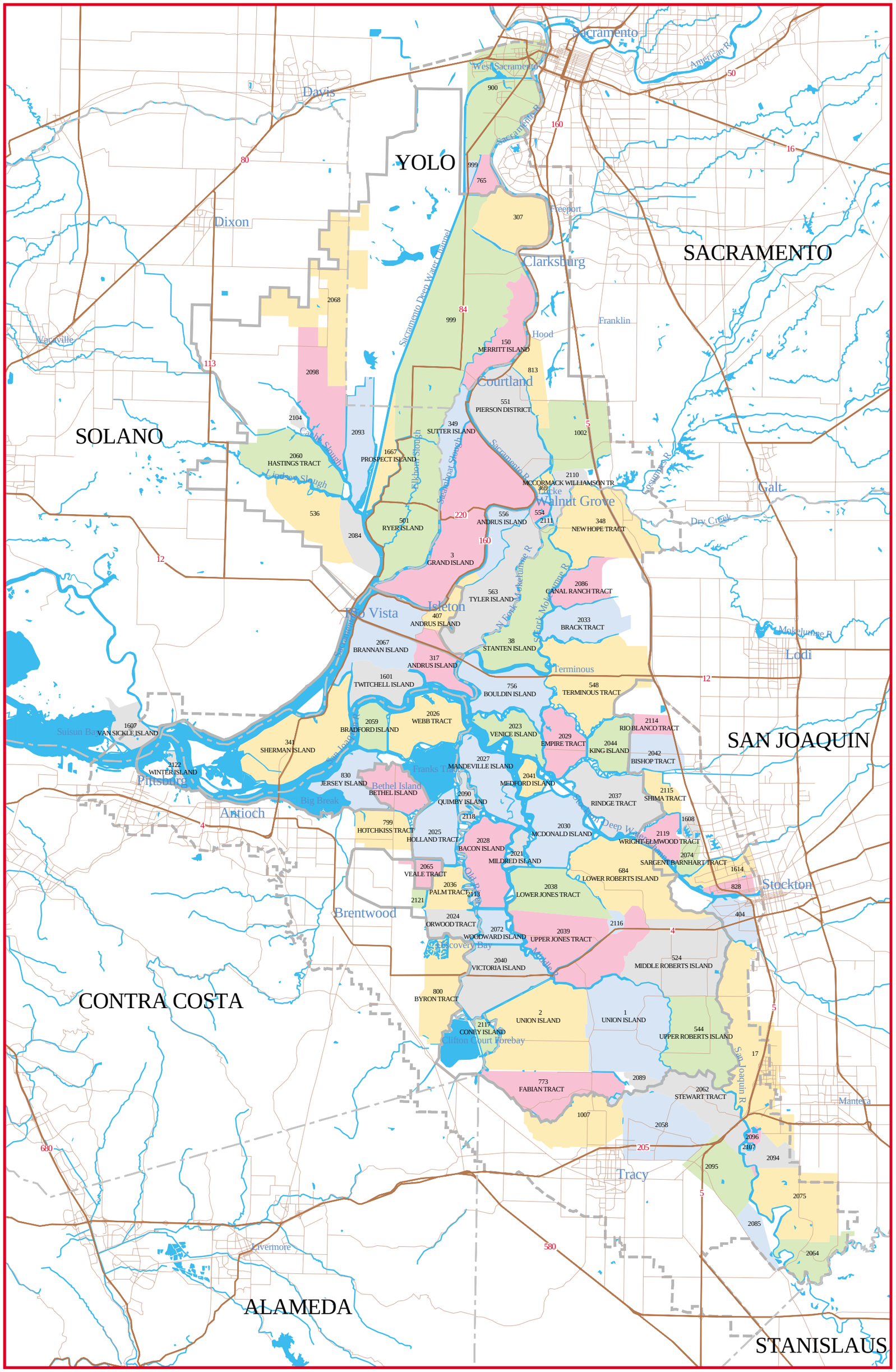
URS Corporation P:\GIS\GIS_Project_Files\MXD\Current Working Documents\Infrastructure\tech_memo_R1_010507\2-7 Railroads.mxd Date: 1/5/2007 11:12:14 AM Name: smlewis0

APPENDIX C

Reclamation Districts Within the Delta

Reclamation Districts

- County Boundary
- Main Surface Streets
- 12 Major Highways
- Hydrography
- Delta Primary Zone
- Delta Secondary Zone



Source: Department of Water Resources
Delta Atlas
1987

Delta Protection Commission

MILES 10

List of Reclamation Districts (RD) Within the Delta

RD1	RD756	RD2028	RD2084
RD2	RD765	RD2029	RD2085
RD3	RD773	RD2030	RD2086
RD17	RD799	RD2033	RD2089
RD38	RD800	RD2036	RD2090
RD150	RD813	RD2037	RD2093
RD307	RD828	RD2038	RD2094
RD317	RD830	RD2039	RD2095
RD341	RD831	RD2040	RD2096
RD348	RD900	RD2041	RD2098
RD349	RD999	RD2042	RD2104
RD369	RD1002	RD2044	RD2107
RD404	RD1007	RD2058	RD2110
RD407	RD1601	RD2059	RD2111
RD501	RD1607	RD2060	RD2114
RD524	RD1608	RD2062	RD2115
RD536	RD1614	RD2064	RD2116
RD544	RD1667	RD2065	RD2117
RD548	RD2021	RD2067	RD2118
RD551	RD2023	RD2068	RD2119
RD554	RD2024	RD2072	RD2121
RD556	RD2025	RD2074	RD2122
RD563	RD2026	RD2075	Bethel Island
RD684	RD2027		

APPENDIX D

Response Actions Table

Table D-1. Current Delta-Wide Emergency Response Actions Identified During Document Discovery Phase

Response Action	Response Action Number	Region(s) Affected	Action Type			Responsible Party	Comments on Action	Reference(s)
			L	O	P			
IMMEDIATE RESPONSE ACTIONS (First day)								
GENERAL AND LIFE SAFETY								
Activate SEMS Functions within DWR	GS-I-1			O		DWR DFM	Constraint - Director must make Mobilization Declaration This will be a Delta-wide effort. DWR will likely be coordinating with the 5 Delta counties, LMAs, the OES REOC, USACE, and USBR. As needed, DFM will send representatives to OES' SOC and REOC and establish liaison with USACE, CDF, and CCC.	13, 19
Mobilize emergency response crews and incident command teams	GS-I-2			O		DWR DFM, O&M	Work with CDF, CYA, CCC, etc.	3, 4, 7, 19
Activate Flood Operations Center	GS-I-3	Sacramento		O		DWR DFM	The FOC coordinates with OES' Inland REOC when a Delta emergency occurs. The FOC is also the link to the field response level and to the USACE.	13, 19
Activate Delta Area Command Center	GS-I-4	Local		O		DWR CDO	Activate in accordance with CDO's Delta Area Command Center Operations Manual. Coordinate closely with FOC.	4, 13
Coordinate with local, state, federal, and private entities	GS-I-5			O		DWR DFM, O&M	This will be a Delta-wide effort. DWR will likely be coordinating with the 5 Delta counties, LMAs, the OES REOC, USACE, and USBR.	4, 19
Utilize aerial reconnaissance of Delta to determine extent of flooding	GS-I-6			O		DWR DFM	Constraint - Light, weather, cloud cover; aircraft availability Should be prearranged.	2, 6
Utilize RIMS and the California Levee Database to report and update all levee incidents.	GS-I-7	Sacramento		O		DWR DFM		4, 13, 19
Notify and update media and public of situation	GS-I-8			O		DWR Office of Public Information and Communication		14, 19

L = Legal
O = Operational
P = Physical

Table D-1 (Continued)								
Response Action	Response Action Number	Region(s) Affected	Action Type			Responsible Party	Comments on Action	Reference(s)
			L	O	P			
Inspect Delta-area earth and concrete dams	GS-I-9			O		DFM, DSOD, O&M, USACE, LMAs		18, 19
Restrict public access to Delta waterways and transportation corridors	GS-I-10	Local		O		USCG, CHP, Caltrans, Local EM and law enforcement		14, 16, 18
Route traffic around the Delta or divert shipments to other locations	GS-I-11	Local		O		Caltrans, CHP, Local Law enforcement	DWR must coordinate with Caltrans to identify items described in section VIId of doc #18. (Specify items in fact sheet.)	16, 18
Initiate Flood Evacuation Plan for RDs that have flooding or are in imminent danger of flooding	GS-I-12			O		Local EM Agencies, RDs	Specific evacuation plans developed in accordance with RD procedures.	21
FLOOD FIGHTING AND LEVEE REPAIR								
Prioritize flood fighting efforts	FF-I-1		L	O		DWR DFM	Constraint - Immediately available resources and management teams Priority is damaged levees on islands that have not breached; more details on priorities can be developed using the DRMS Emergency Response & Repair analysis module.	
Re-task levee repair and critical erosion work	FF-I-2	Varies		O	P	DWR DFM, USACE	Constraint - Time to disengage activity in the Sacramento River basin and transport equipment to newly designated sites in the Delta. Navigation may be constrained by bridge outages around the Delta.	
Mobilize marine-based repair contractors	FF-I-3			O		DWR DFM	Dutra and others qualified and needed: prearrange.	
Retrieve and use stored equipment and material	FF-I-4			O	P	DWR DFM, Office of State Water Planning	The Program maintains four flood emergency supply and equipment storage depots. One is located at the Central District Headquarters in Sacramento, while the other three sites are located in the Delta at Twitchell Island, Brannan-Andrus State Park, and H.O. Banks Pumping Plant.	12
Activate the Levee System Integrity Program	FF-I-5			O		CBDA, DWR, DFG, USACE	This program will establish a fleet of specialized equipment and operators to a rapid emergency response.	12
Initiate Public Law 84-99 request process	FF-I-6		L	O		DWR, USACE	Flood fighting emergency response requests between DWR and the USACE.	12

L = Legal
O = Operational
P = Physical

Table D-1 (Continued)								
Response Action	Response Action Number	Region(s) Affected	Action Type L	Action Type O	Action Type P	Responsible Party	Comments on Action	Reference(s)
WATER SUPPLY AND WATER QUALITY OPERATIONS								
Halt Delta diversions to Clifton Court Forebay	WS-I-1			O	P	DWR, O&M, Delta Field Division	No constraint; simply need clear SOP Need to consider special case of power failure.	1
Decrease CVP C.W. "Bill" Jones Pumping Plant (formerly Tracy Pumping Plant) exports	WS-I-2		L	O	P	USBR-CVO	No constraint; simply need clear SOP Maintain essential/high priority requirements in the reaches to San Luis Reservoir.	2
Request that CCWD halt exports (Old River and Rock Slough)	WS-I-3			O	P	CCWD	No constraint; simply need clear SOP	1
Open the Delta Cross Channel	WS-I-4			O	P	USBR-CVO	Constraint - Must coordinate with ESA agencies regarding protection of fish and SWRCB regarding D-1641 requirements. Open cross channel gates (only if Sac river flow is less than 25K cfs). In the summer they are usually open. Spring and Fall are sometimes open. Winter required to be closed (to protect migrating fish). In the winter, consultations with ESA agencies and the SWRCB are needed to open the gates).	2
Increase New Melones releases	WS-I-5			O	P	USBR-CVO	Increase 2,000 cfs.	2
Increase Folsom releases	WS-I-6			O	P	USBR-CVO	Constraint - Water availability; 1 Day Travel Time for Releases Increase 5,000 cfs.	2
Decrease SWP Banks Pumping Plant exports	WS-I-7		L	O	P	DWR, O&M	Constraint - No constraint; simply need clear SOP Maintain essential/high priority requirements in the reaches to San Luis Reservoir.	2
Halt CVP C.W. "Bill" Jones Pumping Plant (formerly Tracy Pumping Plant) exports, if very low Delta inflow or more than two islands flooded	WS-I-8		L	O	P	USBR-CVO	Constraint - Coordinate with suspending high priority uses and protecting facilities Implement as quickly as possible while protecting canal from rapid draw down.	1
Inspect Delta facilities of the CVP (including Delta Mendota Canal)	WS-I-9				P	USBR-CVO	Constraint - Immediately available staff; need clear SOP and priorities	2

L = Legal
O = Operational
P = Physical

Table D-1 (Continued)								
Response Action	Response Action Number	Region(s) Affected	Action Type			Responsible Party	Comments on Action	Reference(s)
			L	O	P			
Inspect Delta facilities of the SWP (including the California Aqueduct)	WS-I-10				P	DWR, O&M	Constraint - Immediately available staff; need clear SOP and priorities	2, 18
Halt SWP Banks Pumping Plant exports, if very low Delta inflow or more than two islands flooded	WS-I-11		L	O	P	DWR, O&M	Constraint - Coordinate with suspending high priority uses and protecting facilities Implement as quickly as possible while protecting aqueduct from rapid draw down.	2
Increase Oroville releases	WS-I-12			O	P	DWR, O&M	Constraint - Water availability; 2-3 Day Travel Time for Releases Increase 3,000 cfs.	2
Increase Shasta releases	WS-I-13			O	P	USBR-CVO	Constraint - Water availability; 3-5 Day Travel Time for Releases Increase 4,000 cfs.	2
Request Delta farmers to suspend diversions	WS-I-14			O		DWR O&M	Constraint - Depends on voluntary cooperation Must be very carefully presented.	2
Conduct short-term modeling (1-4 week outlook) forecasts of hydrodynamics and salinity within the Delta	WS-I-15			O		DWR DFM	The DRMS Water Analysis Module can be used to assist in this.	1, 2
Evaluate the need for continuing or increased reservoir releases	WS-I-16			O		DWR DFM, O&M, USBR	The DRMS Water Analysis Module can be used to assist in this.	2
Collect real-time salinity data to assess the extent of salinity intrusion into the Delta	WS-I-17			O	P	DWR, O&M, DES, DFD, DPLA, USGS, CCWD		1
Fill Clifton Court Forebay on the next high tide	WS-I-18			O	P	DWR, O&M	Constraint - Need clear rationale and SOP This action may not be advisable as stated, but was identified in Emergency Water Plan. This action would also depend on salinity in the Delta.	2

L = Legal
O = Operational
P = Physical

Table D-1 (Continued)								
Response Action	Response Action Number	Region(s) Affected	Action Type L	Action Type O	Action Type P	Responsible Party	Comments on Action	Reference(s)
SHORT-TERM RESPONSE ACTIONS (2 to 5 days)								
GENERAL AND LIFE SAFETY								
Conduct damage surveys on levees	GS-S-1				P	DWR DFM, DPLA, DSOD, RDs, LMAs		18
FLOOD FIGHTING AND LEVEE REPAIR								
Short-term reinforcements to weakened levees using sheet piles, riprap, and visquine	FS-S-1	Local			P	DWR DFM, CCC, CDF, USACE	Details on priorities can be developed using the DRMS Emergency Response & Repair analysis module.	-
Protecting the inboard levee slopes with plastic and sandbags to prevent wave wash erosion	FS-S-2	Local			P	DWR DFM, CCC, CDF, USACE	Details on priorities can be developed using the DRMS Emergency Response & Repair analysis module.	6
Armoring the inboard levee slopes and any other necessary areas with rock to prevent wave wash erosion	FS-S-3	Local			P	DWR DFM, CCC, CDF, USACE	Details on priorities can be developed using the DRMS Emergency Response & Repair analysis module.	6
Providing flood fight efforts on neighboring islands that may sustain increased underseepage distress	FS-S-4	Local			P	DWR DFM, CCC, CDF, USACE	Details on priorities can be developed using the DRMS Emergency Response & Repair analysis module.	6
WATER SUPPLY AND WATER QUALITY OPERATIONS								
Develop an overall incident water management response strategy	WS-S-1			O		DWR Incident Command, O&M, USBR-CVO	Constraint - Complexity and unknowns Requires examples for reference and training/ practice.	1, 2
Conduct longer-term hydrodynamic and reservoir management modeling	WS-S-2			O		DWR O&M, USBR-CVO	Constraint - Needs model readily adaptable to incident DRMS water analysis model connects reservoir management with hydrodynamics and represents breaches.	1, 2
Review and confirm or refine all Day-1/immediate actions	WS-S-3			O		DWR O&M, USBR-CVO	Ensure conformance to overall strategy.	-

L = Legal
O = Operational
P = Physical

Table D-1 (Continued)								
Response Action	Response Action Number	Region(s) Affected	Action Type			Responsible Party	Comments on Action	Reference(s)
			L	O	P			
Request reservoir releases from San Joaquin River and East Delta Tributaries (Comanche, New Hogan, New Don Pedro, Lake McClure, etc.)	WS-S-4			O	P	DWR O&M, USBR-CVO	Constraint - Depends on voluntary cooperation This action was identified by DWR staff, not included in a reference document; must be very carefully presented.	DWR Staff
Request Sacramento Valley water users to curtail diversions	WS-S-5			O	P	DWR O&M, USBR-CVO	Constraint - Depends on voluntary cooperation Must be very carefully presented.	2
Request San Joaquin Valley water users to curtail diversions	WS-S-6			O	P	DWR O&M, USBR-CVO	Constraint - Depends on voluntary cooperation Must be very carefully presented.	2
Remove temporary south Delta barriers to increase circulation and flushing	WS-S-7				P	DWR O&M	DWR staff identified this action; it was not included in a reference document (need to confirm positive impact before doing this: impact is likely to vary based on specific Delta inflows [especially San Joaquin River] and levee breach locations). Unknown if this action has been modeled to determine impact.	1, DWR Staff
MID-TERM RESPONSE ACTIONS (6 to 14 days)								
GENERAL AND LIFE SAFETY								
Governor relaxes existing water quality and environmental standards	GS-M-1		L			Executive Order	This will spark debate; needs to be carefully developed.	2
Restoration of power to non-flooded islands to allow return pumps to remove applied & seepage water	GS-M-2	Local		O	P	Local Power Suppliers/Utility Companies		DWR Staff
FLOOD FIGHTING AND LEVEE REPAIR								
Place riprap and wave erosion protection on the interior of flooded islands	FF-M-1	Local			P	DWR DFM	Details on priorities can be developed using the DRMS Emergency Response & Repair analysis module	2, 7
Armoring the edges of the levee breach to prevent the breach from widening	FF-M-2	Local			P	DWR DFM	Details on priorities can be developed using the DRMS Emergency Response & Repair analysis module	2

L = Legal
O = Operational
P = Physical

Table D-1 (Continued)								
Response Action	Response Action Number	Region(s) Affected	Action Type			Responsible Party	Comments on Action	Reference(s)
			L	O	P			
WATER SUPPLY AND WATER QUALITY OPERATIONS								
Install temporary barriers in the Sacramento River and Steamboat Slough to increase Delta Cross Flow	WS-M-1				P	DWR	The DRMS Water Analysis Module can be used to assist in this.	2
Install temporary barriers around Franks Tract	WS-M-2				P	DWR	Action not consistent with those being modeled by MWD.	17
Install temporary barrier on San Joaquin River upstream of Rough & Ready Island	WS-M-3				P	DWR O&M	Action not consistent with those being modeled by MWD.	2
Install existing DWR South Delta Temporary barriers (when export resumes, if warranted)	WS-M-4				P	DWR O&M	Action not consistent with those being modeled by MWD.	3, 8
LONG TERM RESPONSE ACTIONS (15+ Days)								
GENERAL AND LIFE SAFETY								
Choose to not recover/ dewater select islands	GS-L-1		L	O		DWR, OES		2, 6, 9
FLOOD FIGHTING AND LEVEE REPAIR								
Close levee break(s)	FF-L-1	Local			P	DWR DFM	Details on priorities can be developed using the DRMS Emergency Response & Repair analysis module.	2
Breach closure and pump out would not commence until the economic feasibility and benefits of full restoration have been determined	FF-L-2	Local			P	DWR DFM	The determination on island restoration will be based on guidance in DWR's Interim Levee Repair Policy.	6
WATER SUPPLY AND WATER QUALITY OPERATIONS								
Monitor salt content in channels; decrease reservoir releases and resume pumping as salt content permits	WS-L-1			O	P	DWR O&M, USBR-CVO	The DRMS Water Analysis Module can be used to assist in this.	1, 2, 3
Repair damage to EBMUD Mokelumne Aqueduct	WS-L-2	Local			P	EBMUD, likely joint responsibility	Action identified in 1986 Emergency Water Plan, unsure who is responsible for implementing this action.	2

L = Legal
O = Operational
P = Physical

Table D-1 (Continued)								
Response Action	Response Action Number	Region(s) Affected	Action Type			Responsible Party	Comments on Action	Reference(s)
			L	O	P			
Remove temporary barriers as a long-term response action	WS-L-3	Local, potentially Delta-wide			P	DWR		-
Connect Contra Costa Canal to Mokelumne Aqueduct to provide water to CCWD or EBMUD	WS-L-4				P	USBR, likely joint responsibility	Action identified in 1986 Emergency Water Plan, unsure who is responsible for implementing this action.	2
Install pipeline on Martinez Bridge to transfer water from North Bay Aqueduct to CCWD	WS-L-5				P	DWR, likely joint responsibility	Action identified in 1986 Emergency Water Plan, unsure who is responsible for implementing this action.	2
Install pipeline on Carquinez Bridge to transfer water from North Bay Aqueduct or Marin County to EBMUD or CCWD	WS-L-6				P	DWR		-
Use California Aqueduct check structures & pumps to reverse flow of California Aqueduct to supply South Bay Aqueduct or South Delta	WS-L-7				P	DWR O&M		2
Dredging of Stockton Deep Water Ship Channel to allow resumption of cargo traffic to Port of Stockton	WS-L-8				P	Unknown	Action identified in Senate Presentation, unsure who is responsible for implementing this action.	7

L = Legal
O = Operational
P = Physical

Table D-2. Potential Future Delta-Wide Emergency Response Actions that will be Considered in Subsequent EOP Phases

Response Action	Response Action Number	Region(s) Affected	Action Type			Responsible Party	Comments on Action	Reference(s)
			L	O	P			
POTENTIAL FUTURE RESPONSE ACTIONS								
Release Clifton Court Forebay water on low tides to repulse salinity from the South Delta channels	To be assigned later				P	DWR O&M	Constraint – Potential Future Action New potential action for analysis and consideration.	No reference
Sink rock barges at strategic locations	To be assigned later				P	DWR	Constraint – Potential Future Action Action identified in DWR table but reference could not be found. Questions whether this action is feasible.	No reference
Widen the DCC gate structures	To be assigned later				P	USBR-CVO	Constraint – Potential Future Action New potential action for analysis and consideration.	No reference
Block saline water from entering the South Delta by deploying Central Delta barriers	To be assigned later				P	DWR	Constraint – Potential Future Action Actions may include: • Close permanent bridge and slide gate structures • Install/deploy tethered barge at strategic locations • Operate/deploy permanent or temporary bottom hinged (Obermyer) gates • Barriers at the Sacramento River confluences with Sutter and Steamboat Sloughs • Rapidly deploy barriers along an east-west alignment of fortified levees in the south Delta (such as south of the Empire Cut alignment or north of the Union Pacific alignment) • Barriers at the Sacramento River confluences with Sutter and Steamboat Sloughs • Rapidly deploy barriers along an east-west alignment of fortified levees in the south Delta (such as south of the Empire Cut alignment or north of the Union Pacific alignment)	1

L = Legal
O = Operational
P = Physical

Table D-3 References Identified in Tables D-1 and D-2

Reference Number	Name	Author	Date
1	DRMS Deliverables 1A – Presentation 1B – Project Scope Report 1C – Infrastructure data and impact analysis 1D – Island populations and impact analysis	DWR	2006
2	Sacramento-San Joaquin Emergency Water Plan – Report to the Legislature	DWR	December 1986
3	State Water Contractors PowerPoint Presentation – Status Update Delta Operations Contingency Planning	State Water Contractors	January 17, 2007
4	Water Resources Engineering Memorandum Number 63a Draft Update	DWR	October 2005 (Last official publication February 1999)
5	Sacramento San Joaquin Delta Atlas	DWR	1993, Reprinted July 1995
6	Interim State Emergency Response Policy for Island Flooding In the Sacramento-San Joaquin Delta	DWR/OES	October 2005
7	PowerPoint Presentation – Thinking the Unthinkable – Are We Ready for Major Floods in the Delta? Interim Hearing. How a Delta Earthquake Could Devastate California's Economy	Senate Subcommittee on Delta Resources, Senate Transportation and Housing Committee, Joint Committee and Emergency Services and Homeland Security	November 2005
8	Emergency Operations Plan for the Spring Head of Old River Barrier	DWR	March 2005
9	Flood Warnings: Responding to California's Flood Crisis	DWR	January 2005
10	Delta Area Command, Joint Operations Manual – Draft (Plan not received)	Unknown	January 2003
11	MOU, CALFED Levee Program Co-Management Plan – Draft (Plan not received)	Unknown	June 2001
12	Delta Levee Emergency Management and Response Plan – Final Draft	CALFED Bay-Delta Program	September 23, 1999
13	Report on Sacramento- San Joaquin Delta Levee Emergency Response Plan – Draft	DWR	May 1998
14	Protocol for Closure of Delta Waterways, Completed in Compliance with FEAT Initiative #7, Governor's Executive Order W-156-97	OES	November 21, 1997
15	Actions and Priorities: Delta Flood Protection Act – Eight Western Delta Islands	DWR – Division of Planning	March 1990
16	Flood Protection of State Highways in the Sacramento-San Joaquin Delta	DWR, Central District	December 1987
17	PowerPoint Presentation – Franks Tract Pilot Project	DWR	2006-2007
18	Memorandum Report State of California Department of Water Resources Response to Catastrophic Disasters in California – Final	Ernest James, PE and Charles McCullough, PE	November 28, 1994
19	State-Federal Flood Operations Center, Flood Emergency Operations Manual	DWR	February 2002
20	PowerPoint Presentations 20A – Through-Delta Facility and Delta Cross-Channel Projects 20B – Through Delta Facility and Delta Cross-Channel Re-operation	20A – Sean Bagheban 20B – Author Unknown	
21	County Emergency Operations Plans 21A – Contra Costa County Emergency Operations Plan 21B – Sacramento County (Plan not received) 21C – San Joaquin County Multi-Hazard Emergency Operations Plan 21D – Solano County Emergency Operations Plan	21A – Contra Costa County Office of the Sheriff, Emergency Service Division 21B – Unknown 21C – San Joaquin County Emergency Services Council	21A – January 2006 21B – Unknown 21C – August 1994 21D – Unknown 21E – Unknown

Reference Number	Name	Author	Date
	21E – Yolo County Emergency Operations Plan (Plan not received)	21D – Unknown 21E – Unknown	
22	FEMA – Sacramento Levee Response Plan (Plan not received)	FEMA	Unknown
23	State of California Emergency Plan	OES Planning Section	September 2005

APPENDIX E

Response Action Summary Sheets

TABLE OF CONTENTS

Appendix E: **Page**

TABLE OF CONTENTS (Continued)

Appendix E: (cont'd) **Page**

Appendix F: **Page**

ACTIVATE SEMS FUNCTIONS WITHIN DWR GS-I-1

SOURCE: Ref. 13, Ref. 19

RESPONSIBLE PARTY: DWR DFM

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

- DWR policy is to operate in compliance with SEMS. The DFM has the lead responsibility to assure all divisions within DWR operate in compliance with SEMS.
- DWR operations center coordinates with OES Inland and Coastal Regional Operations Centers when a Delta emergency situation arises. DWR operations center is considered to be the link to the field response level.

ACTION CHARACTERISTICS
Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

IMPACT:

- Cost-effective supplement to levee protection.
- Prompt response and action can help alleviate levee failure, which can endanger public safety and inundate thousands of acres of farmland. Levee failures can cause significant salinity intrusion into the Delta.
- To prevent loss of life and reduce property damage caused by floods.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	NA	L	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- State OES coordinates the civil defense efforts of Federal, State, and local agencies.
- State OES also maintains a liaison with the DWR during all flood emergencies.
- Only the Governor can declare a State emergency.
- The OES is the designated coordinator during a state of emergency and assigns functions to State agencies to be performed proceeding and during an emergency through prearranged Administrative Orders. Among those functions assigned to DWR during a response to an emergency, DWR is required by administrative order from OES to:
  - Alert personnel and mobile resources in affected areas;
  - Coordinate emergency response with Federal, State, local, and other agencies;
  - Provide flood fighting services needed to protect lives and property;
  - Provide flood protection, flood control, and flood fighting services and related support; and
  - Furnish communications support to the State emergency organization.
- In a mobilization declared by the Director of DWR, the DFM can utilize any of DWR's personnel, equipment, or other resources to fight the flood in accordance with ICS process. Human resources

consist of the DFM's Flood Project Inspection Section to monitor the endangered areas, plus personnel from the Division of Planning and Local Assistance, CDO to monitor high water.

- When OES has activated the Inland REOCS, DFM can also obtain flood fighting crews for the Delta through the Inland REOCS as requested by local Delta levee districts and as coordinated through their corresponding Operational Areas. The crews come from the CCC and through the CDF, which provide inmate crews from the Department of Corrections.
- During an emergency, DFM will:
  - Send representatives to the OES SOC and REOC when necessary.
  - Establish a liaison with the USACE, the CDF, and the CCC as needed.
  - Locate, assess, and report to OES damage to the Sacramento–San Joaquin Rivers flood control projects.
- After an emergency and upon request, DFM will provide personnel to OES to support recovery operations, and will coordinate such requests with DWR.
- At the request of DFM, the Central District will support and supplement DFM's flood fighting efforts for the Delta, to ensure an adequate span of control within DFM's ICS and SEMS structure. In large-scale emergencies, Central staff may be requested to activate a Delta Area Command Center in accordance with the Central District's Area Command Center Operations Manual.
- All activities of the Delta Area Command Center will be closely coordinated with the FOC.
- The FOC is located in Sacramento, California, at DWR JOC and is a component of the DFM's Flood Operations Branch and Emergency Response Section.
- Due to signed agreements, the name of the FOC is the State-Federal FOC; however it can be called the FOC. The FOC is a State-level EOC.
- A DWR Operations Center may be established at the FOC in response to non-flood emergencies impacting DWR.
- The Flood Emergency Operations Manual describes the coordination of Federal, State, and local agency activities at the State-Federal FOC before and during flood events and emergencies, and is designed to provide a general overview for personnel working at the FOC. All flood operations are planned, coordinated, and executed under guidelines established by California's SEMS.
- DWR has established SEMS-structured Emergency Response and Incident Command Teams to respond to emergencies throughout the State.
- During flood emergencies, DWR also furnishes DWR representatives to the Governor's OES REOCs in Sacramento, Oakland, and Los Alamitos, as necessary. The FOC may provide representatives to county Operational Area EOCs per request by the county or its jurisdictional REOC.
- The Director, Chief Deputy Director, Deputy Directors, and the Emergency Preparedness Manager represent the Directorate during flood emergencies. They have ultimate responsibility for DWR's emergency response efforts. They serve as a liaison to and communicate with the Governor's office as well as other State and Federal agencies involving DWR policy issues.
  - Director - Responsibilities of the Director include issuing Flood Mobilization declaration, advising the Governor and staff on emergency conditions and their status, and responding to the Governor's and Legislators' concerns and requests.
  - Chief Deputy Director - Responsibilities of the Chief Deputy Director include acting as an alternate for the Director during 24-hour rotational shifts; providing an administrative liaison for the Deputy Directors, the Emergency Preparedness Manager, and the Division Chiefs; and providing OES with complete and timely fiscal documentation.
  - Deputy Directors - The Director or Chief Deputy Director may assign the following responsibilities to Deputy Directors: acting as a liaison between the Director, the Chief Deputy Director, the Division Chiefs, and the FOC and Emergency Response Team Directors; activating and assembling the Department Operations Center staff; and determining its location.

    - Emergency Preparedness Manager - The Emergency Preparedness Manager normally assumes the role as the Department Operations Center Director. A division chief may be assigned by the Director or Deputy Director to act as a Department Operations Center Director if the Emergency Preparedness Manager is unavailable. The assistants to the Deputy Directors may also act as a Department Operations Center Director if the Emergency Preparedness Manager or chiefs are unavailable. The Emergency Preparedness Manager also designates DWR Agency Representatives for each OES REOC.
- On the regional level, OES operates three REOCs in California, which are located in Sacramento (Inland Region), Oakland (Coastal Region), and Los Alamitos (Southern Region). Each REOC supports and coordinates OES functions within mutual aid regions. If an Operational Area EOC is activated, the jurisdictional REOCs will be activated to coordinate emergency operations and respond to requests for resources and mutual aid. The REOCs will coordinate information and resources between Operational Areas and provide a point of liaison to Federal agencies, including the USACE through DWR representatives at the REOCs. DWR will provide a representative to each activated REOCs to assist in flood fight activity coordination.
- When a REOC is activated, the OES SOC will be activated to support the regions with State agency resources, i.e., CDF, CCC, CNG, etc., and to coordinate Statewide mutual aid and Federal aid. In addition to the SOC other State agencies involved in emergency response activities may operate Department Operations Centers. The FOC is an example of a State-level EOC and is not normally referred to as a Department Operations Center. DWR may establish a Department Operations Center at the resources building so that executive management may oversee the overall DWR response to an emergency, particularly when multiple emergency response teams are activated in addition to the FOC.
- When the FOC is activated, the five primary FOC functions of management, operations, planning/intelligence, logistics, and finance/administration are established as separate “sections” of the FOC organization. All five functions must be present regardless of the level of assigned personnel or magnitude of emergency response. Within each section there may be several sub-functions that are normally established as units. The determination of the appropriate level of staffing to manage the function is the responsibility of the FOC Director and the other four Section Chiefs. In general, the following conditions will apply:
    - Staff each section with the most qualified person in the discipline most closely aligned to the emergency.
    - Maintain a span of control not to exceed one supervisor for up to seven sub functions.
    - One person may have delegated authority for more than one area of responsibility. Usually this is done during the early portion of the Activation Phase or in the Demobilization Phase.
    - Each of the five functional areas can be expanded or contracted as needed into more or fewer organizational units.
    - If one of the other four sections is not activated the FOC Director will perform its duties.
- A chapter within the Flood Emergency Operations Manual describes each section and roles within each section.
    - Within the Management Section there are the following positions: FOC Director, Deputy FOC Director, PL 84-99 Unit, and Public Information Officer. Rumor Control Coordinator, Liaison Officer, Safety Officer, Security Officer, DWR Executive Representative, USACE Representative, and Reclamation Board Representative.
    - Within the Operations Section there are the following positions: Section Chief, Deputy Section Chief, Flood Fight Specialists, Initial Attack Incident Commanders, Geotechnical Unit, Incident Status Unit, Technical Specialists, Resource Coordinator Unit, and Agency Representatives.

- Within the Planning/Intelligence Section there are the following positions: Section Chief, Deputy Section Chief, Situation Status Unit, Incident Reports Unit, Flood Information Specialists, Geographical Information System Unit, Documentation Unit, Decision Support Systems Unit, Advance Planning Unit, Action Plans Unit, Technical Services, River Forecasting, NWS Representatives, State OES Representative, Local Agency Representative, and California Data Exchange Center.
- Within the Logistics Section there are the following positions: Section Chief, Personnel Unit, Supply/Procurement Unit, Facilities Unit, Transportation Unit, Communications Unit, Information Systems Unit, and Resource Status Unit.
- Within the Finance/Administration Section there are the following positions: Section Chief, Time Keeping Unit, Compensation and Claims Unit, Purchasing Unit, and Recovery Unit.

MOBILIZE EMERGENCY RESPONSE CREWS AND INCIDENT COMMAND TEAMS — GS-I-2

SOURCE: Ref. 3, Ref. 4, Ref. 7, Ref. 19

RESPONSIBLE PARTY: DWR DFM, O&M

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

- The DFM's FOC shall serve as the Department Operations Center. Any other DWR unit receiving a call for Delta assistance, or having knowledge of a levee-endangering incident, shall immediately inform the FOC.
- Local agencies have primary authority for both the maintenance of levees and flood fighting. Levee maintenance is provided by public levee and reclamation districts, local government entities, private levee owners, and in some cases by DWR. Collectively, these agencies are referred to as LMAs. Flood fighting on levees is the primary responsibility of the LMAs, which will assume the role of the Incident Commander in most circumstances. If a flood fight exceeds the capability of the LMAs, or if communities are threatened, the responsible city or county will provide assistance with support from all other SEMS levels.
- The FOC or its designee, upon contact from the LMAs, shall determine the need for assistance and may send a flood fight and/or technical specialist to the site. The FOC shall assume leadership for DWR's participation in the incident.
- During large flood events, staff in other Divisions (e.g., Central District staff in the Division of Planning and Public Assistance) may be requested to operate an Incident Command Post. The FOC shall coordinate with other units within DWR having flood incident reporting responsibilities, to ensure that staff is properly trained in these procedures.
- DFM's FOC, or its designee, will represent DWR whenever DWR is called to advise or otherwise participate in emergency response to Delta incidents, whether or not there is an immediate danger of levee failure. In order to maintain a proper span of control under SEMS, the FOC may delegate the representative role.

ACTION CHARACTERISTICS

Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

- Sustained severe storms and flooding may require further DWR personnel, equipment, material, and financial resources for an extended period. To meet this need the Director may, upon the recommendation of the Chief of the DFM, declare a Flood Mobilization. When a Flood Mobilization is declared DFM is authorized to use any DWR personnel and make expenditures beyond budgeted funding. When a Flood Mobilization is declared, a Flood Mobilization declaration memorandum must be prepared and distributed.

IMPACT:

- Loss of life and property.
- Without quick-response crews and teams, catastrophic failure within the Delta could lead to degraded water supply; damage to people's homes and habitat for 500 species; and loss of highways, pipelines, power distribution, railroads, and deep water ports could occur.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	NA	L/M	M	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- During Flood Alerts and Flood Mobilizations, Section personnel fill many of the key positions in the FOC Operations Section. Inspectors may be dispatched as Flood Fight Specialists or Initial Attack Incident Commanders to investigate reported flood incidents and to provide technical assistance. When dispatched to a flood incident they are frequently teamed with a geotechnical expert from the USACE.
- DWR has established SEMS-structured Emergency Response and Incident Command Teams to respond to emergencies throughout DWR. In addition to standing Emergency Response Teams for the FOC, the Eureka Flood Center, and DOE geotechnical specialists, several field Incident Command Teams have been established to respond to flood and other emergencies impacting the DWR. During flood emergencies DWR also furnishes DWR Representatives to the Governor's OES REOCs in Sacramento, Oakland, and Los Alamitos as necessary. The FOC may provide representatives to county Operational Area EOCs per request by the county or its jurisdictional REOC.
- The four Districts support and supplement flood emergency response activities in coordination with the FOC. The Districts have established SEMS-based Incident Command Teams to respond to any emergency at the District level, and to coordinate with and supplement DWR's overall emergency response. Each District has appointed Flood Fight Coordinators who may serve as liaisons to the FOC providing status updates concerning related district flood fighting activities. During flood emergencies the Coordinators and other team members may, at the request of the FOC, serve as primary or supplemental SEMS duty personnel at the FOC or other EOCs, and to establish and staff Incident Command Posts.

- The Departmental Services Office of the Division of Management Services provides key personnel to the FOC to support the Logistics Section. The Logistics Section is responsible for all services and support needs including obtaining and maintaining facilities, personnel, equipment, and supplies for the FOC and all other DWR Emergency Response Teams and Incident Command Posts.
- Facilities Management personnel are assigned to the FOC to ensure adequacy of FOC facilities, those facilities of other DWR Emergency Response Teams, and to support temporary facilities acquired for Incident Command Posts.
- Mobile equipment personnel are assigned to the FOC to acquire transportation resources and support the FOC. This may include securing transportation and equipment as needed for emergency response, transportation of work crews and materials to and from incident locations, and coordinating air reconnaissance missions.
- When facilities of the SWP are threatened by flooding the Division of O&M coordinates activities at each incident with the FOC. Emergency response teams have been established in each Field Division to provide a SEMS-based emergency response organizational structure. Headquarters personnel may also be assigned to the FOC to provide technical expertise as required.

ACTIVATE FOC GS-I-3

SOURCE: Ref. 13, Ref. 19

RESPONSIBLE PARTY: DWR

REGIONS AFFECTED: Action in Sacramento

RESPONSE ACTION DESCRIPTION:

- DFM makes the determination when to open the FOC.
- All levee problems shall be reported to the FOC independent of the threat classification. The Division of Flood management will provide an updated report to the Delta reclamation districts. The FOC shall maintain 24-hour communications through an answering service and personnel on call at home.
- The FOC shall also coordinate with the Inland REOC in a state of emergency.
- Forecasts of sustained storm patterns and resulting flood potentials, coordination of field operations, or requests for technical support from local agencies may require the Flood Operations Branch Chief to declare a Flood Alert to officially activate the FOC under the SEMS. When the FOC is activated, personnel report for duty on shifts as directed by the Chief of the Flood Operations Branch (functioning under SEMS as the FOC Director) to provide up to 24-hour staffing.
- If additional personnel resources beyond the capability of the DFM are needed to staff the FOC under extended hours (which typically happens under Flood Alert status) they will be requested first from the Division of Planning and Local Assistance Headquarters and District Offices and then from other DWR's divisions and offices.
- The FOC may provide representatives to county Operational Area EOCs per request by the county or its jurisdictional REOC.

ACTION CHARACTERISTICS

Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

IMPACT:

- Prompt response and action can help alleviate levee failure, which can endanger public safety and inundate thousands of acres of farmland, residences, and other infrastructure (highways, railroads, and utilities). Levee failures can cause significant salinity intrusion into the Delta.
- To prevent loss of life and reduce property damage caused by floods.
- Provides a centralized source of factual information and technical expertise regarding flood conditions and forecasts to help in these efforts, and a single, multi-agency facility from which DWR can efficiently coordinate flood emergency response.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	NA	L	L	L	L/M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- DFM determines when to open the FOC. The Division's Flood Fight Specialist directs emergency response during a flood alert. In person or through an inspector, DFM investigates reports of levee distress, dealing directly with the island superintendent or other representatives, and guides in the decision making process to best avert a levee failure. If the situation is an immediate threat to the levee, DFM has the lead responsibility within the Department to define and initiate the immediate action necessary to mobilize the required resources.
- The FOC coordinates with the State EOC when activated.
- The State EOC maintains a liaison with the FOC during all flood emergencies.
- The FOC is located in Sacramento, California at DWR's JOC and is a component of the DFM's Flood Operations Branch and Emergency Response Section.
- The FOC is to serve as a focal point for gathering, analyzing, and disseminating current flood information, and to manage the Department's overall flood emergency response.
- The FOC serves as a year-round focal point for gathering, analyzing, and disseminating hydrometeorological information to cooperating agencies, emergency managers, law enforcement, the news media, and the public. During emergencies the FOC provides a centralized source of factual information and technical expertise regarding flood conditions and forecasts to help in these efforts, and a single, multi-agency facility from which DWR can efficiently coordinate flood emergency response.
- When a severe storm pattern or other flood potential develops the Flood Operations Branch may require additional personnel to be temporarily assigned to the FOC to meet increasing information needs of the public, media, emergency assistance, and flood management agencies.
- The NWS Sacramento Weather Forecast Office and CNRFC are co-located with the FOC at the JOC building in Sacramento.
- For levee-endangering incidents, the FOC, upon request, shall provide technical advice to LMAs in meeting their responsibilities for first response to levee endangering incidents, and advise LMAs to contact their Operational Area (as defined under SEMS) for mutual aid assistance and resources.
- DFM personnel share FOC duty. Personnel monitor responsibilities with the assistance of a telephone answering service to provide 24-hour response coverage for incoming emergency calls throughout the year.

ACTIVATE DELTA AREA COMMAND CENTER GS-I-4

SOURCE: Ref. 4, Ref. 13

RESPONSIBLE PARTY: DWR CDO

REGIONS AFFECTED: Local/ varies by location of event

RESPONSE ACTION DESCRIPTION:

- In large-scale events, Central District staff may be tasked to activate a Delta Area Incident Command Post.
- All activities of the Delta Area Incident Command Post will be closely coordinated with the FOC.

ACTION CHARACTERISTICS
Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

IMPACT:

- Prompt response and action can help alleviate levee failure, which can endanger public safety and inundate thousands of acres of farmland, residences, and infrastructure. Levee failures can cause significant salinity intrusion into the Delta.
- To prevent loss of life and reduce property damage caused by floods.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	NA	L	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- DWR Central District administers the Delta Levees Subventions and Special Flood Control Projects Programs, to provide flood control assistance year round to Delta levee maintaining agencies. Because of these program responsibilities, Central District staff has specific experience and knowledge of the Delta, including levee engineering, environmental issues, hydrology, hydrodynamics, geography, and specific levee areas of concern. Central District has also established relationships with Delta levee maintaining agencies, and conducts regular inspections of Delta levees in cooperation with levee maintaining agencies representatives who will be of further assistance to DFM for optimization of the flood fight process. Central District may be tasked to activate a Delta Area Incident Command Post.
- Upon request of the FOC, Central District will support and supplement DFM's flood fighting coordination efforts, for the Delta, to ensure an adequate span of control within DFM's ICS/SEMS structure.
- In small-scale emergencies, and upon request of the FOC, Central District will provide assistance to the FOC. For large-scale emergencies, Central District staff may be tasked to activate a Delta Area Incident Command Post.
- In large scale emergencies, Central District's flood fighting assistance may include, but is not limited to:

- Coordinating and providing information related to the status of flood emergency response;
- Coordinating with the FOC and Delta levee maintaining agencies for mutual aid resources;
- Procuring and dispatching flood fighting materials;
- Coordinating with the FOC for levee inspections and high water monitoring and staking;
- Providing engineering and technical assessment; and
- Coordinating with the FOC for review of PL 84-99 assistance requests.

COORDINATE WITH LOCAL, STATE, FEDERAL, AND PRIVATE ENTITIES — GS-I-5

SOURCE: Ref. 4, Ref. 19

RESPONSIBLE PARTY: DWR DFM, O&M

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

- DWR will likely coordinate with counties within the Delta, LMAs, OES, USACE, and USBR.
- The FOC shall coordinate with all activated Operational Areas to determine whether levee maintaining agencies and State resources can meet the emergency response need. If the combined resources are insufficient, the FOC shall prepare a request for USACE emergency response assistance under PL 84-99 for the Director's signature.
- The FOC shall also facilitate field coordination and provide technical expertise for the levee maintaining agencies in incidents that involve the USACE.
- For levee-endangering incidents, the FOC, upon request, shall provide technical advice to levee maintaining agencies in meeting their responsibilities for first response to levee-endangering incidents, and advise levee-maintaining agencies to contact their Operational Area (as defined under SEMS) for mutual aid assistance and resources.
- DWR is to coordinate local, State, and Federal flood fight activities.

ACTION CHARACTERISTICS
Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

IMPACT:

Without cooperation, efforts undertaken may not be effective and actions ineffectual due to the limited resources of single entities.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	NA	M	M	M	M/H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- DWR is the lead State agency for flood fight assistance. While Section 128(b) of the CWC reaffirms the authority of the Governor's OES to "coordinate and supervise State action, upon a declaration of a State emergency, under the California Emergency Services Act," Section 128(a) describes DWR separate, permissive authority: "In times of extraordinary stress and of disaster, resulting from storms

and floods the department may perform any work required or take any remedial measures necessary to avert, alleviate, repair, or restore damage or destruction to property having a general public and State interest. In carrying out that work, the department may perform the work itself, or through or in cooperation with any other State department or agency, the Federal Government, or any political subdivision, city, or district."

- Upon request, DWR DFM provides technical advice on flood fighting. DWR technical assistance may be requested directly through DWR, or through the local emergency coordinator.
- During emergencies, the FOC provides a centralized source of factual information and technical expertise regarding flood conditions and forecasts to help in these efforts, and a single, multi-agency facility from which DWR can efficiently coordinate flood emergency response.
- The NWS and DWR, DFM, Hydrology and Flood Operations Office have effectively coordinated flood forecasting and warning activities for many years.
- When facilities of the SWP are threatened by flooding the Division of O&M coordinates activities at each incident with the FOC.
- The Flood Operations Office cooperates with a number of local agencies during flood emergencies. During a Flood Alert, DWR may provide technical assistance to advise local agencies about how to establish levee patrols, establish flood fight operations, investigate specific flood incidents, and coordinate requests for emergency assistance.
- OES operates three REOCs in California, which are located in Sacramento (Inland Region), Oakland (Coastal Region), and Los Alamitos (Southern Region). Each REOC supports and coordinates OES functions within mutual aid regions.
    - If an Operational Area EOC is activated, the jurisdictional REOC will be activated to coordinate emergency operations and respond to requests for resources and mutual aid.
    - The REOC will coordinate information and resources between Operational Areas and provide a point of liaison to Federal agencies, including the USACE through DWR representative at the REOC.
    - DWR will provide a representative to each activated REOC to assist in coordination of flood fight activities.
    - When a REOC is activated, the OES SOC will be activated to support regions with State agency resources, i.e., CDF, CCC, CNG, etc., and to coordinate Statewide mutual aid and Federal aid.

UTILIZE AERIAL RECONNAISSANCE OF DELTA TO DETERMINE EXTENT OF FLOODING — GS-I-6

SOURCE: Ref. 2, Ref. 6

RESPONSIBLE PARTY: DWR DFM

REGIONS AFFECTED:
Deltawide

RESPONSE ACTION DESCRIPTION:

- In response to a need for an updated emergency response plan; an example of a response is to conduct an aerial reconnaissance of the Delta to determine the extent of flooding.
- After an earthquake, dispatch an airplane or helicopter to determine which islands are flooding.

ACTION CHARACTERISTICS
Objective: General Life and Safety
Timeframe: Immediate
Type: Operational

IMPACT:

- Air reconnaissance will assist in detecting the extent of flooding, damage and need for repair.
- Need to protect the Delta water supply and the State's economy.
- Allow for appropriate actions/responses to work based on additional intelligence.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Calm Weather	L	L	M	L	L
Stormy Weather	L	M	M	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- This response should be pre-arranged to ensure quick response and availability of aircraft.

UTILIZE RIMS AND THE CALIFORNIA LEVEE DATABASE TO REPORT AND UPDATE ALL LEVEE INCIDENTS

GS-I-7

SOURCE: Ref. 4, Ref. 13, Ref. 19

RESPONSIBLE PARTY: DWR DFM

REGIONS AFFECTED: None-Action in Sacramento

RESPONSE ACTION DESCRIPTION:

- All Delta levee incidents shall be reported via RIMS and the "California Levee" database by written reports, and verbally, as soon as practicable, upon discovery of an incident.
- Once an initial report has been input in the RIMS, it shall be continuously updated by the FOC (if activated) with all pertinent incident status information until the incident is closed. The FOC, or its designee, shall coordinate all incident-reporting activities.

ACTION CHARACTERISTICS

Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

IMPACT:

Allow for communication to be shared among entities, allows for the collection of data and provides a status of the incident in real-time.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	NA	L	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- Incident Status Unit: This unit obtains information and reports on active flood incidents from personnel in the field. They work in close coordination with the Incident Reports Unit in Planning/ Intelligence to ensure timely updates of the RIMS Flood Incident Reports Database.
- Decision Support Systems Unit: This unit administers access to and operational readiness of the computer-based Decision Support Systems used at the FOC including access to RIMS and the California Data Exchange Center.
- OES Representative: Personnel from the Inland Region of the Governor's OES fill the position of OES Representative when the FOC and one or more REOC are activated. They provide an OES expert on site and promote information exchange between OES, operational areas, DWR, and other cooperating areas. They should have some level of authorization to speak or act for OES. They also provide technical assistance to FOC personnel accessing and interpreting reports in OES' RIMS.

NOTIFY AND UPDATE MEDIA AND PUBLIC OF SITUATION — GS-I-8

SOURCE: Ref. 14, Ref. 19

RESPONSIBLE PARTY: DWR, Office of Public Information and Communication

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

When the FOC is activated, each of the five functional ICS areas will be staffed. A Public Information Office and Rumor Control Coordinator will be activated. The Public Information Officer serves as the primary point of contact between the FOC and the media. A Rumor Control Coordinator is to respond rapidly and with correct and timely information to any and all rumors associated with the emergency.

ACTION CHARACTERISTICS
Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

IMPACT:

To keep the public and the media informed of flooding or other water related emergencies and to reduce the loss of life.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	NA	L	L	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- *DWR DFM* - Certain key units within DFM have unique roles and provide key resources during flood emergencies.
  - Emergency Response Section - This Section in the Flood Operations Branch is responsible for maintaining year-round operational readiness of the FOC including development and implementation of decision support system computer applications and a Geographical Information Systems Unit. The Section leads or assists with coordination and preparation of flood emergency response plans, procedures, and training courses. Section personnel provide year-round acquisition, analysis, and dissemination of water related information to agencies, news media, and the public. Personnel share FOC Duty Monitor responsibilities with the assistance of a telephone answering service to provide 24-hour response coverage for incoming emergency calls throughout the year. During Flood Alerts and Flood Mobilizations the Section fills many of the key positions in the FOC Planning/Intelligence Section.
  - The Office of Water Education provides Information Officers who serve in the FOC Management Section. They may also be assigned to the Eureka Flood Center, to other DWR Emergency Response Teams, and to DWR-established temporary Incident Command Posts. Information Officers coordinate with the Planning/Intelligence Section to help insure the accuracy and

timeliness of flood and emergency response information released to the public and news media. Information includes flood conditions, emergency response, levee-endangering incidents, river and weather forecasts, FOC activities, potential water supply and water quality impacts, and other flood-related issues. The Office of Water Education Chief will also alert the Graphic Services Branch so that photographic and video documentation can be readily obtained.

- *Public Information Officer* – The Public Information Officer serves as the primary point of contact between the FOC and the media (routine public calls are first screened by Flood Information Specialists in the Planning/Intelligence Section and are transferred to the Public Information Officer, if required). Assistant Information Officers may be assigned as needed. A primary source of information for the Public Information function will be from the Planning/Intelligence Chief and Deputy, the Situation Status Unit, and other Technical Specialists in Planning/Intelligence. These personnel have the experience necessary to interpret hydrologic, meteorological, and flood response questions.
    - Public Information Officers also coordinate requests for individual staff interviews and press conferences, develop the format for press conferences in conjunction with the FOC Director, prepare a media-related activities summary once per operational period, act as the initial contact and escort for on-site news media personnel, manage the Media Center, monitor broadcast media using information to develop follow-up news releases and rumor control, coordinate video recordings of televised flood coverage, and coordinate photographic and video services for documentation of flood incidents
- *Rumor Control Coordinator* - The function of rumor control is to respond rapidly and with correct and timely information to any and all rumors associated with the emergency. Rumor control is generally handled as a part of the Public Information function, but may be established as a separate unit within the management staff as necessary. The Rumor Control Coordinator must work closely with the Public Information function and with the Planning/Intelligence Section.
- When waterways are closed, the OES will coordinate with the Department of Boating and Waterways, USCG and affected jurisdictions to issue appropriate media information. Recreational vessel restrictions and/or advisories will be distributed to marinas through the Department of Boating and Waterways. The USCG - Alameda, will issue commercial vessel restrictions and/or advisories.

INSPECT DELTA AREA EARTH AND CONCRETE DAMS — GS-I-9

SOURCE: Ref. 18, Ref. 19

RESPONSIBLE PARTY: DWR DFM, DSOD, O&M, USACE, and LMAs

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

- SOPs within the Division of O&M and in each Field Division require immediate inspection of all facilities of the SWP as soon as possible after an earthquake.

ACTION CHARACTERISTICS
Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

IMPACT:

To prevent loss of life and reduce property damage caused by floods.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Seismic Event	L	L/M	L/M	L	L/M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- *DWR DFM* - The Flood Project Inspection Section in the Flood Operations Branch inspects the maintenance procedures of levee maintaining agencies for levees and other flood control structures in Federally constructed flood control projects located primarily in the Central Valley. Inspectors may be dispatched as Flood Fight Specialists or Initial Attack Incident Commanders to investigate reported flood incidents and to provide technical assistance. When dispatched to a flood incident they are frequently teamed with a geotechnical expert from the USACE.
- The DOE (within DWR) upon request of DFM provides geotechnical inspection and technical assistance during emergencies. Inspectors are frequently paired with a partner from the USACE to support PL 84-99 activities. DOE technical assistance supports flood fight, levee repair and construction, design review, construction contracts administration, and construction inspections.
- DSOD – The DSOD supervises the construction, alteration, maintenance, and operation of non-Federal dams that are 25 feet or higher and impound more than 15 acre-feet of water, and dams that are 6 feet or higher and impound more than 50 acre-feet of water. Figure 3-7 illustrates the regions and areas administered by DSOD.
- DSOD and DFM Emergency Response Section personnel execute year-round protocols for responding to and following up on dam emergencies. All flood damages sustained by dams under the jurisdiction of DSOD are investigated and reported to the FOC.
- DSOD personnel may be assigned to the FOC during flood emergencies to provide technical expertise as required.
- *The USACE* - The USACE has jurisdiction over the flood control operations of reservoirs having Federal flood control reservations space. Levee maintaining agencies (local and State) maintain and

operate levees of the Sacramento River Flood Control Project or other projects of the USACE. The Reclamation Board, as "local sponsor," has provided assurances to the USACE that these Federal projects will be properly maintained and operated. In turn, the levee maintaining agencies have agreed to maintain and operate their portions of the projects, subject to monitoring by The Reclamation Board. DWR personnel from the Flood Project Inspection Section inspect maintenance of Federal levees and report to USACE.

- Engineers from the DSOD, in accordance with its procedures, inspected 102 dams within 9 days after the Loma Prieta earthquake in 1989. Up to seven teams were dispatched in a single day, using four-wheel-drive vehicles and helicopters. The inspection effort was centered on earth and concrete dams within 50 miles of the epicenter. Follow up inspections on 22 dams within 25 miles of the epicenter were also performed to check for after-shock damage and any long term or delayed effects. Contact was maintained with dam owners and OES during this inspection period.
- Response by DWR safety inspectors and O&M personnel may be hampered by limited access through damaged areas. There needs to be coordination with the Caltrans.

RESTRICT PUBLIC ACCESS TO DELTA WATERWAYS AND TRANSPORTATION CORRIDORS — GS-I-10

SOURCE: Ref. 14, Ref. 16, Ref. 18

RESPONSIBLE PARTY: Local Emergency Managers, local law enforcement, USCG, CHP, and Caltrans

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

- Without any emergency proclamations in place, the local government may, under penal code or any existing local ordinance, restrict non-essential vessel traffic on waters within their jurisdiction.
- The USCG has authority to restrict commercial vessel traffic.
- Any agencies requiring non-essential or non-commercial vessel restrictions should contact the County Sheriff of the jurisdiction where the restrictions would be required.
- Any agency requiring commercial shipping restrictions should contact their local OES, who will forward the request to the OES Regional Administrator. OES will convey the request to the USCG Captain, Marine Safety Office, San Francisco Bay.
- Any State agency requiring vessel restrictions will contact the OES Director who, upon verification, will forward the request to the local Sheriff's Department having jurisdiction over the waterway. Any actions concerning waterway restrictions will be coordinated with the Department of Boating and Waterways, USCG, affected law enforcement, and other concerned agencies. The OES Regional Administrator will activate the REOC to the extent necessary to coordinate the interests of local government, the Department of Boating and Waterways, and the USCG Captain, Marine Safety Office, San Francisco Bay.
- DWR is to coordinate with Caltrans where sites with flood conditions affect highways and when access by authorized DWR emergency personnel is needed to access blocked highway facilities.

ACTION CHARACTERISTICS
Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

IMPACT:

- By restricting public access, infrastructure such as waterways and transportation corridors can be repaired, or if applicable reclaimed faster and minimize additional damage by the public.
- By restricting the general public, transportation corridors with already limited access may have the capacity to handle and support emergency personnel.
- Restrictions will provide for flood fight priorities and control of vessel wakes that may exacerbate levee erosion or overtopping.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	L	M	M/H	M/H	M/H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- Requests for restrictions on recreational or commercial vessels should indicate the following information:
  - Agency or jurisdiction requesting restrictions;
  - The reason for the restrictions (debris, unsafe water velocity, emergency work, etc.);
  - The type of restrictions and/or advisories (speed controls, nonessential recreational vessel restrictions, etc.);
  - Duration of the restriction and/or advisory;
  - Special considerations (day time or night restrictions only, etc.); and
  - The process to review and remove restrictions.
- For non-commercial recreational vessels, restriction enforcement will be coordinated with local law enforcement agencies.
- For commercial shipping, the USCG has the responsibility for enforcement of any restrictions on commercial vessel traffic and will coordinate their activities with OES during proclaimed emergencies.
- Vessel restrictions and/or advisories will be issued for a set period of time determined by consultation with OES, Department of Boating and Waterways, USCG, and affected local jurisdictions. Before the expiration date of the restrictions and/or advisories, OES, Department of Boating and Waterways, the USCG, and affected local emergency managers, will issue a joint statement lifting the restrictions. Distribution of the statement will follow the same procedures previously outlined under public notifications.
- When flooding occurs, sections of the State highway must be closed or traffic must be restricted. Maintenance forces are required to provide temporary traffic control such as flagging. In instances of longer closures, more permanent traffic control devices may be necessary. Caltrans will provide flood response to flooding on State roads and highways.

ROUTE TRAFFIC AROUND THE DELTA OR DIVERT SHIPMENTS TO OTHER LOCATIONS — GS-I-11

SOURCE: Ref. 16, Ref. 18

RESPONSIBLE PARTY: Local law enforcement, CHP, Caltrans

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

- Infrastructure such as Highway 160, Highway 12, natural gas and oil pipelines, and railroad embankments could fail due to an earthquake or flooding in the Delta.

ACTION CHARACTERISTICS

Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

IMPACT:

- A Delta earthquake could disrupt transportation in the Bay/Delta region, interrupt rail and truck deliveries, and lead to a shortage of natural gas.
- Without re-routes, the Port of Stockton could be shut down.
- Without re-routes, there could be a loss to the economy and loss of jobs.
- Major roads, such as I-5 and Highways 4 and 12 could be impacted.
- Bridges and ferry service may be shut down and prevent crossing of waterways.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	L	M	M/H	M/H	M/H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- Highway maintenance forces place signs to warn motorists of partial road closures on impacted travelways.

INITIATE FLOOD EVACUATION PLAN FOR RDS THAT HAVE FLOODING OR ARE IN IMMINENT DANGER OF FLOODING — GS-I-12

SOURCE: Ref. 21

RESPONSIBLE PARTY: Local Emergency Management Agencies, RDs

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

- Evacuation plans are required for existing mobile homes, mobile home parks, or recreational vehicle parks located within a flood zone. These plans are required and reviewed by the Community Development Department.
- The public safety agencies of San Joaquin County will support the efforts of RDs to maintain levees and conduct evacuation and rescue operations if necessary.

ACTION CHARACTERISTICS
Objective: General and Life Safety
Timeframe: Immediate
Type: Operational

IMPACT:

- Preventing risks to the general public as population and population densities increase in the Delta.
- Flooding can cause hundreds of million of dollars of damage to public facilities and private property.
- To minimize loss of life.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	L	L	M/H	M/H	M/H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- RDs are responsible for maintenance of their levee systems. They will establish levee patrols and will take immediate action to correct levee problems. Public safety agencies are responsible for ensuring public safety in the event of a flood. These agencies will support the efforts of the RDs to maintain levees and conduct evacuation and rescue operations if necessary.
- Local emergency managers will activate the Operational Area EOC for multi-agency coordination as appropriate.
- DWR is responsible for the maintenance of SWP levees and for providing early warning and information on river stages. It will also support the efforts of RDs within its mandates.
- Local agencies should:
  - Direct the development of warning and evacuation action plans if dam or levee failures are reported to be possible or imminent.
  - Determine the need to advise persons in risk areas to prepare for evacuation.

- If flooding appears imminent, initiate warning and evacuation plans. Coordinate evacuation of the inundation area. Work with Operations Section to implement and revise as necessary the Incident Action Plan.
- Direct the Care and Shelter Manager to prepare a mass care plan.
- Activate emergency medical care in case of need in evacuations.

PRIORITIZE FLOOD FIGHTING EFFORTS FF-I-1

SOURCE: Ref. 1

RESPONSIBLE PARTY: DWR DFM

REGIONS AFFECTED:
Deltawide

RESPONSE ACTION DESCRIPTION:

During this response action, resources and personnel will be directed to flood fight locales based on the prioritization of efforts. The FOC shall use a pre-determined set off response priorities when developing the plan and procedures for rapidly and efficiently collecting disaster intelligence immediately following a disaster. This intelligence will then be used to prioritize response activities, allocate available resources, and specifically request resources from other sources to save and sustain lives and protect water quality and water supply in the Delta.

ACTION CHARACTERISTICS
Objective: Flood Fight and Levee Repair
Timeframe: Immediate
Type: Legal/Operational

IMPACT:

The result of this action will be a focused flood fight response and a clear directive on what areas to focus efforts.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Process Development	L	M	M	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

This prioritization process has not yet been developed. The process should include prioritizing which islands and levees should be protected and maintained and to what levels during a disaster. Priorities should be developed based on data from the DRMS Emergency Response and Repair analysis module. The likely priority will be damaged levees on islands that have not yet breached to prevent flooding, which would then minimize damage. The next priority would then be to repair levees on flooded islands, such as preventing wind erosion and capping the ends of levee breaches. Lower priority would be to close the breach and begin the restoration and dewatering process.

RE-TASK LEVEE REPAIR AND CRITICAL EROSION WORK — FF-I-2

SOURCE: NA

RESPONSIBLE PARTY: DWR DFM, USACE

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

Following a State of Emergency declaration by Governor Schwarzenegger and signing of Executive Order S-01-06, DWR was tasked with identifying and repairing eroded levee sites on the State/Federal levee system. These repairs are expected to continue over several years, as eroded sites are further identified. These repairs include placing rock slope protection on the waterside of the levee to re-establish the damaged levee slope and reduce risk of erosion in the future. Rock is transported to the pre-identified erosion sites by barge or truck. During a catastrophic event in the Delta resulting in multiple levee failures, the crews assigned to the repair of critical erosion sites will be re-tasked to mobilize to Delta areas of failure.

ACTION CHARACTERISTICS

Objective: Flood Fights and Levee Repair
Timeframe: Immediate
Type: Operational/Physical

IMPACT:

The result of this action would be to assign repair crews as quickly as possible to the failed or at-risk areas. These crews would have previous knowledge and experience with this type of repair work. The mobilization of crews would be dependent on their ability to disengage from the work site and navigation may be constrained due to bridge outages or other barriers throughout the Delta.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	M	M	H	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments: None

MOBILIZE MARINE-BASED REPAIR CONTRACTORS — FF-I-3

SOURCE: NA

RESPONSIBLE PARTY: DWR DFM

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

During a large-scale, multiple levee breach scenario, marine-based contractors will need to be mobilized as expeditiously as possible. This will require existing contract mechanisms that can be "turned on" quickly to get work started. These marine-based contractors will provide experienced personnel and equipment (rock barges with mounted cranes) to armor weakened levees and close any breaches.

ACTION CHARACTERISTICS

Objective: Flood Fight and Levee Repair
Timeframe: Immediate
Type: Operational

IMPACT:

The selection of marine-based contractors should be based on their ability to get quickly to the damaged areas. The first contractors mobilized will likely be those involved with the ongoing erosion repair work in the Delta, the Sacramento and San Joaquin Rivers, and their tributaries. Contractors will then be selected based on proximity to the Delta. It may be necessary to develop a list of out-of-State/ international contractors along the Pacific Coast.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	M	M-H	H	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Having quarry materials and rock to place may be a limiting factor for mobilizing crews. The San Rafael Rock Quarry (owned by the Dutra Group) is the primary rock supplier in the Delta because of its location and ability to directly load barges. If necessary, other quarries are located in Catalina island, Mexico, and British Columbia.

RETRIEVE AND USE STORED EQUIPMENT AND MATERIALS — FF-I-4

SOURCE: Ref. 12

RESPONSIBLE PARTY: DWR DFM, Office of State Water Planning

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

The Delta Levees Program (component of the Office of State Water Planning) maintains four flood emergency supply and equipment storage depots, one in Sacramento and three in the Delta. These supply depots contain equipment and materials essential to flood fight efforts.

ACTION CHARACTERISTICS
Objective: Flood Fight and Levee Repair
Timeframe: Immediate
Type: Operational/Legal

IMPACT:

The depots are located at the Central District Headquarters in Sacramento, Twitchell Island, Brannan-Andrus State Park, and H.O. Banks Delta Pumping Plant. The Central District depot contains the majority of the District's flood fight equipment including chain saws, shovels, picks, rain gear, weed eaters, and safety equipment. The Delta depots maintain a supply of sand bags, geo-textile material, visquine plastic sheeting, buttons, twine, and wooden stakes. The depots also serve as primary coordination areas for delivery of flood fighting supplies to various islands.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	L	L	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

In addition to the supplies of the Delta Levees Program, CALFED's Levee System Integrity Program has purchased supplies and is working to locate up to 10 truck and helicopter-transportable flood fight boxes. These boxes would contain 100,000 sand bags, plastic sheeting, wood stakes, and hand tools and would be available for transport anywhere in the Delta.

ACTIVATE THE LEVEE SYSTEM INTEGRITY PROGRAM — FF-I-5

SOURCE: Ref. 12

RESPONSIBLE PARTY: California Bay-Delta Authority, DWR, CDFG, USAFE

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

DWR, the CDFG, and the USACE implement the California Bay-Delta Authority's Levee System Integrity Program. The program takes a leadership role in working with the Delta counties and local RDs and coordinating with OES. The program has implemented a Levee Emergency Management and Response Plan that will be followed during a levee emergency.

In addition to a coordination role, the program has purchased supplies available for flood fight.

ACTION CHARACTERISTICS
Objective: Flood Fight and Levee Repair
Timeframe: Immediate
Type: Operational

IMPACT:

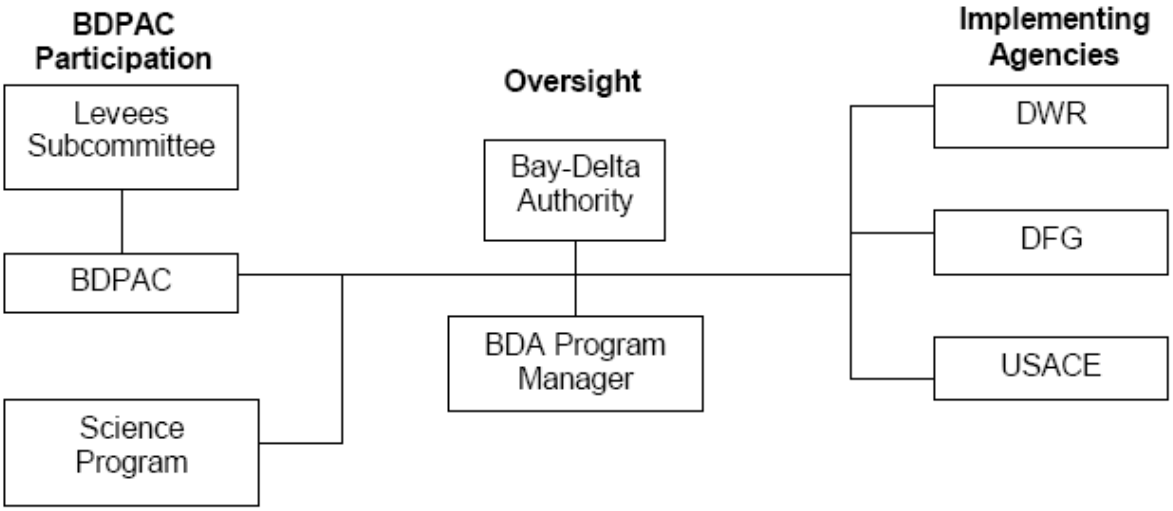
The California Bay-Delta Authority's Levee System Integrity Program conducts projects to reduce the risk to land and associated economic activities, water supply, infrastructure, and ecosystem from catastrophic breaching of Delta levees. The Levee System Integrity Program is implemented by DWR through their existing Delta Levees Program. The Program provides grant opportunities and awards subventions funds for maintaining and improving levee system integrity and conducting engineering studies for levee construction and repair. Only LMAs are eligible for the program.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	NA	L	NA	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

According to CALFED's Levee Systems Integrity Program Plan, Year 7, the coordination matrix is as follows:



Roles and responsibilities within this structure are as follows:

Agency	Roles and Responsibilities
California Bay Delta Authority	• Oversight
DWR	• Program Management • Subventions • Special Projects • Subsidence • Emergency Response • Beneficial Reuse • Risk Assessment • Suisan Marsh
USACE	• Program Management • Base Level Protection and Special Improvements • Emergency Response • Beneficial Reuse
CDFG	• Program Management • Subventions Environmental Review • Special Projects Environmental Review • Preserving/Improving Delta Net Habitat
RDs	• Planning • Levee Maintenance • Levee Improvements • Habitat Mitigation • Emergency Response

INITIATE PL 84-99 REQUEST PROCESS FF-I-6

SOURCE: Ref. 12

RESPONSIBLE PARTY: DWR, USACE

REGIONS AFFECTED:
Deltawide

RESPONSE ACTION DESCRIPTION:

During any emergency event, DWR may request assistance during flood fight or repair of Federal levees from the USACE. PL 84-99 authorizes USACE to rehabilitate flood control structures damaged or destroyed by floods. DWR is the State's liaison to the USACE for its emergency assistance, under PL 84-99. The USACE can provide emergency flood fight assistance under its PL 84-99 authority on local levees that either protect populated areas or public infrastructure, or have "pre-qualified" for PL 84-99 by meeting USACE structural criteria.

ACTION CHARACTERISTICS
Objective: Flood Fight and Levee Repair
Timeframe: Immediate
Type: Legal/Operational

IMPACT:

A representative of the USACE will staff DWR's FOC. The USACE can coordinate their operations through the FOC and have their own dedicated resources within the FOC; the USACE can act as an advisor on DWR's flood response efforts.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	NA	L	NA	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

USACE provides Federal assistance under PL 84-99 when required levels of flood fighting exceed State and local resources. During a flood event USACE will provide local authorities resources and technical assistance based on USACE past flood fighting experience and answer requests for assistance in flood fighting received through DWR. DWR's director shall sign any request for PL 84-99 assistance. If the request meets USACE criteria (legislative mandate), they will assume management of the flood fight and all emergency repairs.

USACE has responsibility over Federal levees and also has jurisdiction over the flood control operations of reservoirs having Federal floods control space. USACE has made agreements with local LMAs to maintain Federal project levees. DWR personnel from the Flood Project Inspection Section inspect LMA maintenance of Federal levees and report to USACE.

DWR and USACE signed an updated MOU in 1999 to facilitate the working relationship and provide a better understanding of agency roles and responsibilities during a flood emergency. The 1999 MOU was organized in accordance with SEMS and included SOPs for Responding to Flood Emergencies Under PL

84-99. Through USACE, DWR may request additional assistance, personnel, equipment, and supplies, for flood fighting, rescue, and relief work. During incidents when PL 84-99 assistance is anticipated, DWR will typically conduct a joint investigation with a USACE geotechnical expert.

HALT DELTA DIVERSIONS TO CLIFTON COURT FOREBAY — WS-I-1

SOURCE: Ref. 1

RESPONSIBLE PARTY: DWR O&M, Delta Field Division

REGIONS AFFECTED: South, Central

RESPONSE ACTION DESCRIPTION:

Upon report of a low-Delta-inflow, multiple-island flooding event, immediately halt diversions from the Delta to Clifton Court Forebay by closing the gates if they are open.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality
Timeframe: Immediate
Type: Operational/Physical

IMPACT:

Reduction of South Delta diversions will decrease the influx of salinity into the central and southern Delta. This is important because the southern Delta is very difficult to flush.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Inflow, Multi-Island	L	L	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

There are essentially no limitations or difficulties in implementing this action. The only requirements are recognition of its advisability and clear communication between Incident Command and the Responsible Party (DWR O&M). Development of a Standard Emergency Operating Procedure and operator training will facilitate smooth implementation.

In a major seismic event, the Clifton Court Forebay gates may not be operable due to loss of power (verify with DWR O&M). In this instance, the essential emergency operation would still be possible if the DWR O&M develops and implements gate closing capability using a portable generator or other operating procedure, including procurement, installation, maintenance, and periodic testing of the required equipment. Additionally, development of a Standard Emergency Operating Procedure, Periodic Testing Procedure, and operator training for loss-of-power gate closing operation will facilitate smooth implementation.

DECREASE CVP C.W. "BILL" JONES PUMPING PLANT (FORMERLY TRACY PUMPING PLANT) EXPORTS

WS-I-2

SOURCE: Ref. 2

RESPONSIBLE PARTY: USBR-CVO

REGIONS AFFECTED: South, Central

RESPONSE ACTION DESCRIPTION:

Upon report of a low-Delta-inflow, multiple-island flooding event, immediately reduce Tracy export pumping to one pump only (approximately 900 cfs).

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Legal/Operational/Physical

IMPACT:

Reduction of export pumping will decrease the influx of salinity into the central and southern Delta. This is important because the southern Delta is very difficult to flush.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Inflow, Multi-Island	L	L	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

There are essentially no limitations or difficulties in implementing this action. The only requirements are recognition of its advisability and clear communication between Incident Command and the Responsible Party (USBR-CVO). Development of a Standard Emergency Operating Procedure and operator training will facilitate smooth implementation.

REQUEST THAT CCWD HALT EXPORTS (OLD RIVER AND ROCK SLOUGH) — WS-I-3

SOURCE: Ref. 1

RESPONSIBLE PARTY: CCWD Operations

REGIONS AFFECTED: Central

RESPONSE ACTION DESCRIPTION:

Upon confirmation of a low-Delta-inflow, multiple-island flooding event, take action to halt CCWD export pumping as quickly as possible, consistent with protecting facilities.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Operational/Physical

IMPACT:

Halting export pumping will decrease the influx of salinity into the Central Delta. This is important because the southern Delta is very difficult to flush.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Inflow, Multi-Island	L	L	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

In a large event occurring with moderate to low Delta inflows, this action is essential and should be implemented as soon as possible. Flooding islands will create a very large demand for water from the Delta channels. Any water that is still pumped for export will result in an equal volume of saline water being drawn farther into the South Delta with an increase in South Delta salinity levels and flushing difficulty. The disruption period may be substantially lengthened if pumping continues, even for several hours.

The only difficulty or limitation in implementing this action is recognition by CCWD that cessation of pumping from the Delta is necessary. The only other requirement is clear communication between Incident Command and the Responsible Party (CCWD Operations). Development of a Standard Emergency Operating Procedure and operator training will facilitate smooth implementation.

It is noted that, in a major seismic event, pumping may immediately stop due to loss of power. In this instance, the preparation for the cessation of pumping mentioned above will assist in smooth accommodation of this eventuality.

OPEN THE DELTA CROSS CHANNEL GATES (IF POSSIBLE) WS-I-4

SOURCE: Ref. 2

RESPONSIBLE PARTY: USBR-CVO

REGIONS AFFECTED: North, Central, South

RESPONSE ACTION DESCRIPTION:

Upon report of a multi-island flooding event, immediately open the Delta Cross Channel gates, provided flow in the Sacramento River is less than 25,000 cfs and provided operators have the discretion to do so under the operating rules per D-1641. If opening is not within operator discretion and the multi-island flooding event is confirmed, initiate urgent consultations through the CALFED Operations Group to permit expedited, emergency opening.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Operations/Physical

IMPACT:

Opening the Delta Cross Channel gates will allow fresh water to flow into the eastern part of the north, central, and south Delta and thereby lessen the influx of salinity into those parts of the Delta during the period that the breached islands are flooding. After flooding is completed and Delta water levels have stabilized, the fresh water from the Delta Cross Channel will facilitate flushing of the north, central, and south Delta.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Summer	L	L	L	L	L
Spring/Fall	M	M	L	M	M
Winter	H	H	L	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

During the summer, the Delta Cross Channel gates are generally open and, if they happen to be closed, operators have the discretion to open them. If the gates are closed and maintenance or some other activity is underway, safety will dictate the operators' ability to respond and speed for doing so.

During the spring and fall, there are periods when a specific number of gates-closed days are required. Dates for open versus closed are established in consultations with the CALFED Operations Group. Operators may have some discretion based on Operations Group guidelines. At a minimum, the Operations Group will need to be kept informed.

During the winter, the gates are required to be closed, per D-1641. Consultations with the Operations Group and the SWRCB will be necessary to determine whether this requirement can be suspended for an emergency.

Opening the Delta Cross Channel gates is one of the highest priority and most effective actions for minimizing the intrusion of salinity into the Delta in a low-flow, multi-island flooding event. After flooding is complete, it is extremely important for increasing the effectiveness of flushing flows entering the Delta from upstream reservoirs on the Sacramento River.

Essential aspects of this action are recognition of its advisability and clear communication between Incident Command and the Responsible Party (USBR-CVO). Development of a Standard Emergency Operating Procedure and operator training will facilitate smooth implementation.

In a major seismic event, the Cross Channel gates may not be operable due to loss of power. In this instance, the essential emergency operation would still be possible if USBR-CVO develops and implements gate opening capability using a portable generator, including procurement, installation, maintenance, and periodic testing of the required equipment. Additionally, development of a Standard Emergency Operating Procedure, Periodic Testing Procedure, and operator training for portable generator gate opening operation will facilitate smooth implementation.

INCREASE NEW MELONES RELEASES WS-I-5

SOURCE: Ref. 2

RESPONSIBLE PARTY: USBR-CVO

REGIONS AFFECTED: South, Central

RESPONSE ACTION DESCRIPTION:

Immediately, upon confirmation of a major low-inflow, multi-island flooding event, perform a calculation to confirm expected flow reversal bringing Suisun Bay water back into the Delta. If flow reversal is confirmed, increase New Melones releases at least 2,000 cfs (per Ref. 2). This action shall be limited by public safety, low-level outlet capacity, downstream channel capacity (even accepting some overbank flooding of crops), or severely limited reservoir storage.

Note: With Delta inflow of 20,000 cfs, 2 days of inflow is approximately 80,000 acre feet. This is less than the flooding volume for a single large island or two to three medium sized islands.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Operational/Physical

IMPACT:

New Melones releases are the most effective upstream resource available for limiting salinity intrusion into the southern and southeastern Delta. New Melones is the only close-by reservoir controlled by the CVP or SWP that can be used to increase the San Joaquin River inflows into the Delta quickly. Ref. 2 indicates the increased flow will arrive in the Delta in approximately 1/2 to 1 day. The releases will be most effective very early in the event, while islands are still filling and before Delta channels and the flooding islands have been filled with saline water from the Bay. Therefore, the releases should begin immediately. Every extra acre foot of released fresh water that arrives in the Delta before channel water levels have stabilized will keep the salinity front further downstream by an equivalent volume of the channels.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low Water Supply	H	M/H	M	H	H
High Water Supply	L	L	M	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation in implementing New Melones releases is availability/entitlement to the water. The CVP operators have indicated that very little CVP discretionary water is available from New Melones storage. Senior water rights holders apparently control almost all the water in storage. Thus, implementing releases from New Melones will require a mechanism for addressing that limitation.

INCREASE FOLSOM RELEASES WS-I-6

SOURCE: Ref. 2

RESPONSIBLE PARTY: USBR-CVO

REGIONS AFFECTED: North, Central

RESPONSE ACTION DESCRIPTION:

Immediately, upon confirmation of a major low-inflow, multi-island flooding event, perform a calculation to confirm expected flow reversal bringing Suisun Bay water back into the Delta. If flow reversal is confirmed, increase Folsom releases at least 5,000 cfs (per Ref. 2). The amount of flow released shall be limited by public safety, low-level outlet capacity, downstream channel capacity, or severely limited reservoir storage.

Note: With Delta inflow of 20,000 cfs, 2 days of inflow is approximately 80,000 acre feet. This is less than the flooding volume for a single large island or two to three medium sized islands.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Operational/Physical

IMPACT:

Folsom releases are the most effective upstream resource available for limiting salinity intrusion into the northern and northeastern Delta. Folsom is the only close-by reservoir controlled by the CVP or SWP that can be used to increase the Sacramento River inflows into the Delta quickly. Ref. 2 indicates the increased flow will arrive in the Delta in approximately 1 day. The releases will be most effective very early in the event, while islands are still filling and before the Delta channels and flooding islands have been filled with saline water from the Bay. Therefore the releases should begin immediately. Every extra acre foot of released fresh water that arrives in the Delta before channel water levels have stabilized will keep the salinity front further downstream by an equivalent volume of the channels.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	M	L	M	M	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation in implementing Folsom releases is availability of the water and/or resulting decreases for uses that would otherwise have occurred. Folsom water is in high demand for local municipal supplies and for cool flows for lower American River fisheries. Thus, implementing releases from Folsom will require a mechanism for addressing and balancing the negative impacts compared with the urgent positive result of early-in-the-event salinity repulsion. It is possible that Folsom releases could be reduced after ± 3 days when Oroville and Shasta releases begin to arrive.

DECREASE SWP BANKS PUMPING PLANT EXPORTS — WS-I-7

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: South, Central

RESPONSE ACTION DESCRIPTION:

Upon report of a low-Delta-inflow, multiple-island flooding event, immediately reduce Banks export pumping to the minimum rate consistent with the protection of facilities (e.g., avoiding aqueduct damage from rapid drawdown downstream).

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Legal/Operational/Physical

IMPACT:

Reduction of Banks export pumping allows conservation of Clifton Court Forebay storage for priority uses to be recognized as the scope and the nature of the emergency becomes better understood. For example, routing available Forebay water to the South Bay Aqueduct may become a priority if a lengthy disruption is foreseen.

If it is not possible to close the Clifton Court Forebay gates, decreasing Banks export pumping will be necessary to decrease the influx of salinity into the central and southern Delta. This is important because the southern Delta is very difficult to flush.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Flow, Multi-Island	L	L	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

There are essentially no limitations or difficulties in implementing this action. The only requirements are recognition of its advisability and clear communication between Incident Command and the Responsible Party (DWR O&Ms). Development of a Standard Emergency Operating Procedure and operator training will facilitate smooth implementation.

HALT CVP C.W. "BILL" JONES PUMPING PLANT (FORMERLY TRACY PUMPING PLANT) EXPORTS — WS-I-8

SOURCE: Ref. 1

RESPONSIBLE PARTY: USBR-CVO

REGIONS AFFECTED: South, Central

RESPONSE ACTION DESCRIPTION:

Upon confirmation of a low-Delta-inflow, multiple-island flooding event, take action to suspend deliveries to all users in the Tracy to O'Neill reach of the Delta Mendota Canal. Cease export pumping as quickly as possible, without subjecting the canal to rapid drawdown. Rapid drawdown must be avoided to prevent possible damage to the canal lining.

Note: Continuation of one-pump operation for 24 hours may draw approximately 1,800 acres of highly saline water into the central and southern Delta.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Legal/Operational/Physical

IMPACT:

Halting export pumping will decrease the influx of salinity into the central and southern Delta. This is important because the southern Delta is very difficult to flush.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Flow, Multi-Island	L	M	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

In a large event occurring with moderate to low Delta inflows, this action is essential and should be implemented as soon as possible. Flooding islands will create a very large demand for water from the Delta channels. Any water that is still pumped for export will result in an equal volume of saline water being drawn farther into the South Delta with an increase in South Delta salinity levels and the difficulty of flushing. The disruption period may be substantially lengthened if pumping continues, even for several hours.

The only difficulty or limitation in implementing this action is coordination to halt deliveries to CVP contractors in the first reach of the Delta Mendota Canal. An orderly cessation of diversions from the canal is necessary so that pumping can be stopped without causing a rapid decrease in water levels in the canal. Such rapid drawdown must be avoided to prevent damage to the canal lining. The only requirements to achieve the needed coordination are recognition that a halt to deliveries is necessary and clear

communication between Incident Command, the Responsible Party (CVP Operations), and the relevant diverters (CVP contractors). Development of a Standard Emergency Operating Procedure and operator training will facilitate smooth implementation.

It is noted that, in a major seismic event, pumping may immediately stop due to loss of power. In this instance, the coordination and communication mentioned above will be essential for halting diversions and thereby preventing rapid drawdown that may damage the canal lining.

INSPECT DELTA FACILITIES OF THE CVP (INCLUDING THE DELTA MENDOTA CANAL FROM TRACY TO O'NEILL) WS-I-9

SOURCE: Ref. 2

RESPONSIBLE PARTY: USBR-CVO

REGIONS AFFECTED:
Deltawide, primarily North and South

RESPONSE ACTION DESCRIPTION:

Immediately upon report or feeling of an earthquake, implement an inspection of CVP facilities in the Delta area, including embankments, dams, gate structures, pumping facilities, pipelines, fish screens, electrical transmission and switchyard facilities, and the Delta Mendota Canal (embankments, lining, and check structures) between C.W. "Bill" Jones Pumping Plant (formerly Tracy Pumping Plant) and O'Neill. The Delta Cross Channel should be included in these inspections.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Physical

IMPACT:

The results of these inspections will be essential to incident managers in evaluating incident impacts, assessing response capabilities, and deciding on response actions.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	L	L	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation in implementing these inspections will be the staff immediately available on duty. An SOP that is responsive to the apparent magnitude and location of the seismic event and that clearly establishes priorities for both operating actions and initial inspections by the staff on hand is essential. Mobilization of supplemental staff responsive to the significance of the event, for follow-up inspections, also will be required.

INSPECT DELTA FACILITIES OF THE SWP (INCLUDING THE CALIFORNIA AQUEDUCT FROM BANKS TO O'NEILL) WS-I-10

SOURCE: Ref. 2, Ref. 18

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: South Delta

RESPONSE ACTION DESCRIPTION:

Immediately upon report or feeling of an earthquake, implement an inspection of SWP facilities in the Delta area, including embankments, dams, gate structures, pumping facilities, pipelines, fish screens, electrical transmission and switchyard facilities, and the California Aqueduct (embankments, lining and check structures) between Banks pumping plant and O'Neill Forebay.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Physical

IMPACT:

The results of these inspections will be essential to incident managers in evaluating incident impacts, assessing response capabilities, and deciding on response actions.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	L	L	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation in implementing these inspections will be the staff immediately available on duty. An SOP that is responsive to the apparent magnitude and location of the seismic event and that clearly establishes priorities for both operating actions and initial inspections by the staff on hand is essential. Mobilization of supplemental staff responsive to the significance of the event, for follow-up inspections, also will be required.

HALT SWP BANKS PUMPING PLANT EXPORTS WS-I-11

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: South, Central

RESPONSE ACTION DESCRIPTION:

Upon confirmation of a low-Delta-inflow, multiple-island flooding event, take action to suspend all diversions in the Banks to O'Neill Forebay reach of the California Aqueduct. Cease Banks export pumping as soon as possible, consistent with protection of facilities (e.g., avoiding damage from rapid drawdown downstream) and close the gates at the check structures between Banks and O'Neill. Rapid drawdown must be avoided to prevent possible damage to the aqueduct lining.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Legal/Operational/Physical

IMPACT:

Halting Banks export pumping allows conservation of Clifton Court Forebay storage for priority uses to be recognized as the scope and nature of the emergency becomes better understood. For example, routing available Forebay water to the South Bay Aqueduct may become a priority if a lengthy disruption is foreseen.

If it is not possible to close the Clifton Court Forebay gates, halting Banks export pumping will help minimize the influx of salinity into the central and southern Delta. This is important because the southern Delta is very difficult to flush.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Flow, Multi-Island	L	M	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The only difficulty or limitation in implementing this action is coordination to halt diversions from the California Aqueduct reach between Banks and O'Neill. An orderly cessation of diversions from the aqueduct is necessary so that pumping can be stopped without causing a rapid decrease in water levels in the aqueduct. Such rapid drawdown must be avoided to prevent damage to the aqueduct lining. The only requirements to achieve the needed coordination are recognition that a halt to deliveries is advisable and clear communication between Incident Command, the Responsible Party (SWP Operations), and the relevant diverters. Development of a Standard Emergency Operating Procedure and operator training will facilitate smooth implementation.

It is noted that, in a major seismic event, pumping may immediately stop due to loss of power. In this instance, the coordination and communication mentioned above will be essential for halting diversions, closing gates at check structures, and thereby preventing rapid drawdown that may damage the aqueduct lining.

INCREASE OROVILLE RELEASES WS-I-12

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: North, Central

RESPONSE ACTION DESCRIPTION:

Immediately, upon confirmation of a major low-inflow, multi-island flooding event, perform a calculation to confirm expected flow reversal bringing a substantial quantity of Suisun Bay water back into the Delta. If flow reversal is confirmed, increase Oroville releases at least 3,000 cfs (per Ref. 2). The flow increase may be limited by public safety, low-level outlet capacity, downstream channel capacity, or severely limited reservoir storage.

Note: With Delta inflow of 20,000 cfs, 2 days of inflow is approximately 80,000 acre feet. This is less than the flooding volume for a single large island or two to three medium sized islands.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Operational/Physical

IMPACT:

Oroville is one of the major upstream resources available for repulsing salinity intrusion from the northern and northeastern Delta. Oroville is large enough to sustain flushing flows for a prolonged period. It is controlled by the SWP and, if available storage is adequate, can be used to increase the Sacramento River inflows into the Delta for several weeks to reestablish fresh water conditions. Ref. 2 indicates that the increased flow will arrive in the Delta in approximately 2 to 3 days. The releases will be most effective very early in the event, before the channel salinity has had a chance to mix extensively with the fresher water in the flooded islands. Therefore, the releases should begin immediately. Every extra acre foot of released fresh water that arrives in the Delta before channel salinity has mixed into the islands will keep the salinity front further downstream by an equivalent volume of the channels and will lessen salinity concentrations in the islands and upstream channels.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Dry Year	H	H	M	H	H
Wet Year	L	L	M	M	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation in implementing Oroville releases is the availability of the water and/or resulting decreases for uses that would otherwise have occurred. Oroville water is in high demand; it is a primary source of water supplies that are exported from the Delta. Thus, implementing releases from Oroville

requires a mechanism for recognizing the availability of some water that would have been exported and also for balancing the potential negative impacts on other uses compared with the urgent positive result of early-in-the-event salinity repulsion. The DRMS WAM is being developed as an evaluation tool to assist with this decision-making. It is expected that evaluations would result in adjustments to the initial Oroville releases in the next several days as more detailed analyses are performed and an incident management strategy is formulated.

INCREASE SHASTA RELEASES WS-I-13

SOURCE: Ref. 2

RESPONSIBLE PARTY: USBR-CVO

REGIONS AFFECTED: North, Central

RESPONSE ACTION DESCRIPTION:

Immediately, upon confirmation of a major low-inflow, multi-island flooding event, perform a calculation to confirm expected flow reversal bringing a substantial quantity of Suisun Bay water back into the Delta. If flow reversal is confirmed, increase Shasta releases at least 4,000 cfs (per Ref. 2). Flow increases shall be limited by public safety, low-level outlet capacity, downstream channel capacity, or severely limited reservoir storage.

Note: With Delta inflow of 20,000 cfs, two days of inflow is approximately 80,000 acre feet. This is less than the flooding volume for a single large island or two to three medium sized islands.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Operational/Physical

IMPACT:

Shasta is one of the major upstream resources available for repulsing salinity intrusion from the northern and northeastern Delta. Shasta is large enough to sustain flushing flows for a prolonged period. It is controlled by the CVP and, if available storage is adequate, can be used to increase the Sacramento River inflows into the Delta for several weeks to reestablish fresh water conditions. Ref. 2 indicates the increased flow will arrive in the Delta in approximately 3 to 5 days. The releases will be most effective very early in the event, before the channel salinity has had a chance to mix extensively with the fresher water in the flooded islands. Therefore, the releases should begin immediately. Every extra acre foot of released fresh water that arrives in the Delta before channel salinity has mixed into the islands will keep the salinity front further downstream by an equivalent volume of the channels and will lessen salinity concentrations in the islands and upstream channels.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	M	L	M	M	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation in implementing Shasta releases is the availability of the water and/or resulting decreases for uses that would otherwise have occurred. Shasta water is in high demand for Sacramento Valley supplies and for cool flows for Sacramento River fisheries. It is also a primary source of water supplies that are exported from the Delta. Thus, implementing releases from Shasta requires a mechanism

for recognizing the availability of some water that would have been exported and for balancing the potential negative impacts on other uses compared with the urgent positive result of early-in-the-event salinity repulsion. The DRMS WAM is being developed as an evaluation tool to assist with this decision-making. It is expected that evaluations would result in adjustments to the initial Oroville releases in the next several days as more detailed analyses are performed and an incident management strategy is formulated.

REQUEST DELTA FARMERS TO SUSPEND DIVERSIONS — WS-I-14

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: North, East, South

RESPONSE ACTION DESCRIPTION:

Upon confirmation of a low-inflow, multi-island flooding event, and expected reverse flow of saline water into the Delta from Suisun Bay, Delta water users (mostly for agricultural irrigation) would be alerted that a salinity influx is anticipated due to multi-island flooding and they should, at a minimum, be cautious so they do not adversely impact their crops by irrigating with saline water. They would also be requested to suspend withdrawals from Delta channels until filling of the flooding islands is complete, water levels have stabilized, and a program for flushing the salinity from the Delta channels is well underway.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Operational

IMPACT:

Reduction/suspension of withdrawals from Delta channels will decrease the influx of salinity into the Delta. This is especially important in the eastern and southern Delta because these portions of the Delta are very difficult to flush.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Inflow, Multi-Island	L	L	L	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation or constraint in implementing this action is the need for very careful and respectful communication of the request made of Delta water users. It must be recognized that the request depends totally on voluntary cooperation by Delta water users. If the request is communicated appropriately, it may be clear to Delta water users that their collective self-interest will be best served by responding positively to the request. This may be their best possibility of achieving usable water quality most quickly.

CONDUCT SHORT-TERM MODELING FORECASTS OF HYDRODYNAMICS AND SALINITY

WS-I-15

SOURCE: Ref. 1, Ref. 2

RESPONSIBLE PARTY: DWR DFM, supplemented by others as required

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

Upon report of a low-inflow, multi-island flooding event, activate an incident management hydrodynamic modeling team to forecast Delta salinity intrusion due to the specifics of the incident. The initial assignment will be to include actual breach locations and islands flooded into an appropriate model and characterize the resulting salinity intrusion for 1 to 4 weeks, given current Delta inflows. Subsequently, the model must be receptive to the input of flow changes based on upstream reservoir releases and to modification of the Delta channel configuration based on removal or installation of barriers and the repair of breaches.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Operational

IMPACT:

These modeling results will be essential as a basis for decisions on appropriate water supply and water quality operation responses to the emergency.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Inflow Island-Flooding	L	L	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Previous hydrodynamic/salinity models for the Delta have been complex, computationally intensive, and relatively inflexible for incorporating breaches, flow alterations, and channel barrier insertions. The DRMS WAM has been specifically designed to overcome these difficulties. Presently, the WAM model is operational, but still undergoing testing and refinement. The incident command/management system needs to assign a hydrodynamic/salinity modeling and interpretation function to a specific team so that appropriate modeling efforts are performed in an efficient, effective, and timely manner to serve the needs of incident command and other incident support teams (e.g., reservoir release decisions, barrier placement, and repair sequence). This activity must be pre-planned so that it can begin immediately upon activation of the ICS and deliver initial forecasts within several hours. It must also anticipate the supplementary model runs that will be desirable so that the required model features can be set up in advance for rapid inclusion in the model.

EVALUATE THE NEED FOR CONTINUING OR INCREASED RESERVOIR RELEASES

WS-I-16

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR DFM, O&M, USBR, supplemented by others as required

REGIONS AFFECTED:
Deltawide

RESPONSE ACTION DESCRIPTION:

Evaluate the need for and availability of/ability to provide special upstream reservoir releases to respond to the salinity repulsion need associated with the levee-breach, island-flooding emergency. The initial assignment will be to evaluate the effectiveness of supplemental releases from New Melones, Folsom, Oroville, and Shasta (given assumed start times and amounts of releases and travel times to the Delta). The second part of the initial assignment will be to evaluate the availability and prospective duration of those supplemental releases, given the time of year and existing storage in each reservoir. The third part of the assignment will be an evaluation of potential requests to other parties for additional Delta flushing releases.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Objectives
Timeframe: Immediate
Type: Operational

IMPACT:

These modeling and evaluation results on useful and acceptable reservoir releases will be essential as a basis for decisions on appropriate water supply and water quality operation responses to the emergency.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Inflow Multi-Island	L	L	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Previous hydrodynamic/salinity models for the Delta have not had capability for easily incorporating interactions with upstream reservoir management and decisions on emergency releases. The DRMS WAM has been specifically designed to overcome this shortcoming. Presently, the WAM model is operational, but still undergoing testing and refinement. The incident command/management system needs to assign a reservoir management/releases modeling and evaluation team to work in cooperation with the hydrodynamic/salinity modeling team to conduct reservoir release needs and water availability evaluations in an efficient, effective, and timely manner to serve the requirements of incident command and other incident support teams (e.g., decision makers on reservoir releases, barrier placement/timing, and repair sequence). This activity must be pre-planned so that it can begin immediately upon activation of the ICS and deliver initial evaluations within 24 hours. It must also anticipate supplementary model runs that will be desirable so that the required model features and data can be set up in advance for rapid inclusion into the model runs.

COLLECT REAL-TIME SALINITY DATA TO ASSESS THE EXTENT OF SALINITY INTRUSION INTO THE DELTA

WS-I-17

SOURCE: Ref. 1

RESPONSIBLE PARTY: DWR O&M, DES, DFD, DPLA, USCG, CCWD

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

Upon report of a low-inflow, multi-island flooding event, monitor the existing ongoing data system for salinity changes and initiate supplemental salinity data gathering as necessary to characterize the actual extent of salinity intrusion into the Delta.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Immediate
Type: Operational/Physical

IMPACT:

These data will be essential as a basis for decisions on appropriate water supply and water quality operation responses to the emergency. They will also be important for confirming the effectiveness of the modeling performed and the decisions/actions taken.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Inflow Island-Flooding	L	L	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Continuous monitoring of salinity now occurs at a number of locations in the Delta. The incident command/management system needs to assign a salinity data monitoring, supplementation, and interpretation function to a specific team so that these data retrieval and management functions are performed in an efficient, effective, and timely manner to serve the need of incident command and other incident support teams (e.g., hydrodynamic modeling). This activity must be pre-planned so that it can begin immediately upon activation of the ICS and deliver initial results within a couple hours. It must also anticipate the desirable supplementary data so that field teams can be immediately directed to key locations for obtaining supplementary data.

FILL CLIFTON COURT FOREBAY ON THE NEXT HIGH TIDE — WS-I-18

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: South, Central

RESPONSE ACTION DESCRIPTION:

Upon report of a low-Delta-inflow, multiple-island flooding event, the Clifton Court Forebay gates would have been closed to halt further diversion from the Delta (and retain the water already stored in the Forebay). This proposed action would now open the gates on the next high tide with the intention of capturing additional fresh water that might still be present in the channels near Clifton Court. Although the action was set forth in the 1986 Delta Emergency Water Plan, it appears to be based on misconceptions. This action may not be advisable and will be re-evaluated for inclusion in the EOP.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality
Timeframe: Immediate
Type: Operational/Physical

IMPACT:

Other response actions are oriented toward reduction of South Delta diversions in order to decrease the influx of salinity into the central and southern Delta. This is important because the southern Delta is very difficult to flush. Filling Clifton Court Forebay would have the opposite effect. It would increase the influx of salinity into the central and southern Delta, increase salinity concentrations, make flushing more difficult, and prolong water use and water export disruption.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Inflow, Multi-Island	H	M	M	M	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The limitations or difficulties in implementing this action are with accurately perceiving its feasibility and consequences.

In a minor event or if the flooded islands are located mainly in the northern or eastern Delta, there may be fresh water in the channels approaching Clifton Court and it may be possible to capture some additional water in the Forebay on the next high tide. However, even if this were true, the action would be inconsistent with what all other Delta diverters are being asked to do, namely halt diversions. It seems inadvisable for DWR to put itself in that position. The consequences of not leading by example may be much more significant than the small benefit of capturing a last additional increment of water.

It is doubtful, in a major low-inflow, multi-island flooding event, that physical conditions in the Delta will allow the intended capture of fresh water on the next higher high tide. Modeling for the 21-island scenario used in DRMS indicated that water levels in channels near Clifton Court Forebay would drop up to ten feet while the channel waters rushed away to fill the flooding islands. There would be no recognizable high tide for 3 to 4 days. And when the channels did refill during the fourth and fifth days, they would refill with salty water. Thus, the action (as conceived and intended) appears to be infeasible.

CONDUCT DAMAGE SURVEYS ON LEVEES GS-S-1

SOURCE: Ref. 18

RESPONSIBLE PARTY: DWR DFM, DPLA, DSOD, RDs, LMAs

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

Inspect Delta levees and document findings.

ACTION CHARACTERISTICS
Objective: General and Life Safety
Timeframe: Short-term
Type: Physical

IMPACT:

It is particularly important to obtain information rapidly, regarding levees that are damaged on islands that have not yet flooded so that evacuations can be ordered (if warranted) and levee repairs can be initiated and supported to prevent more islands flooding.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	L	L	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation in performing these inspections will be the availability of qualified personnel. Great reliance must be placed on the local RDs and State efforts will need to be prioritized to address urgent cases where State action may be needed and effective.

SHORT-TERM REINFORCEMENTS TO WEAKENED LEVEES USING SHEET PILES, RIPRAP, AND VISQUINE

FF-S-1

SOURCE: NA

RESPONSIBLE PARTY: DWR DFM, CCC, CDF, USACE

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

This response action pertains to levee areas that have not yet breached, but have been weakened due to the earthquake movement, seepage, erosion due to wave action, or overtopping. The reinforcements to the weakened levees are temporary methods and cannot be expected to last for extended periods of time. The emergency repair methods may include sandbagging, boil control, wave wash protection, and levee overtopping protection.

ACTION CHARACTERISTICS

Objective: Flood Fight and Levee Repair
Timeframe: Short-term
Type: Physical

IMPACT:

The emergency repair methods are used to prevent levee failure. Temporary flood fight methods have been utilized by DWR and the USACE for many years and have proven very effective at protecting weakened or endangered infrastructure.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	L	M	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

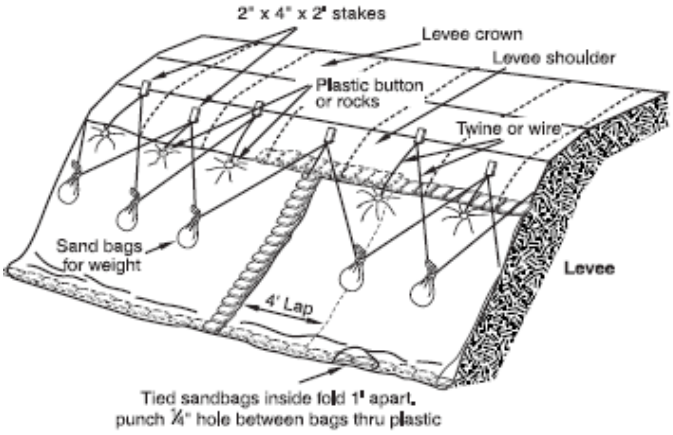
Temporary actions to protect weakened levees include:

Boil Control

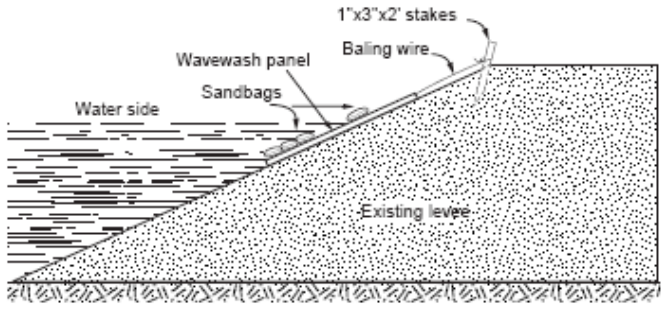
Boil control will involve building a watertight sandbag ring around the boil to reduce flow and prevent further discharge of earthen material. Water should not be prevented from escaping the boil, as this may cause the boil to erupt in another area. The sandbag ring around the boil should effectively encompass the area around the boil and be built to a height ensuring that the velocity of water coming from the boil does not move earth from the levee foundation.

Wave Wash Protection

Levee slopes can be protected from wave wash either by visquine or wooden panels. Visquine wave wash protection involves placing visquine (bought in 20-foot wide by 100-foot long by 10 mil rolls). Wooden stacks and sand bags will be used to hold the visquine in place.



Wood panels may also be used to protect levees from wave erosion. Panels are generally prefabricated, 3 feet high, and 16 feet long. Visquine is preferred, but woods panels may be required in channels with high velocities. The panels will be secured to the levee face with bailing wire, wood stakes, and sandbags.



NOTE: Panels may be placed in a vertical position, depending on existing conditions.

PROTECTING THE INBOARD LEVEE SLOPES WITH PLASTIC AND SANDBAGS TO PREVENT WAVE WASH EROSION

FF-S-2

SOURCE: Ref. 6

RESPONSIBLE PARTY: DWR DFM, CCC, CDF, USACE

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

This response action will be utilized when strong winds accompany high water to prevent wave erosion of levee slopes. Levees adjacent to wide stretches of water should be watched during periods of strong wind to detect the early stages of wave erosion. During sustained periods of strong wind and high water, personnel should stand by to observe and monitor the affected areas.

ACTION CHARACTERISTICS

Objective: Flood Fight and Levee Repair
Timeframe: Short-term
Type: Physical

IMPACT:

Visquine and wood panels can be used to prevent or protect slopes from wave erosion. These methods will be used on sections of levees that have not breached, but may require action to prevent a breach at a later time.

Constraints/Limitations

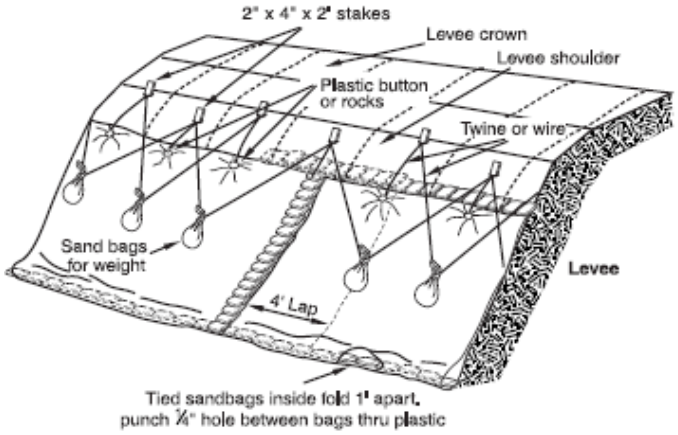
Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	L	M	L	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Wave erosion protection can be fabricated with plastic (Visquine) or wood panels, as described below:

Visquine Wave Erosion Protection

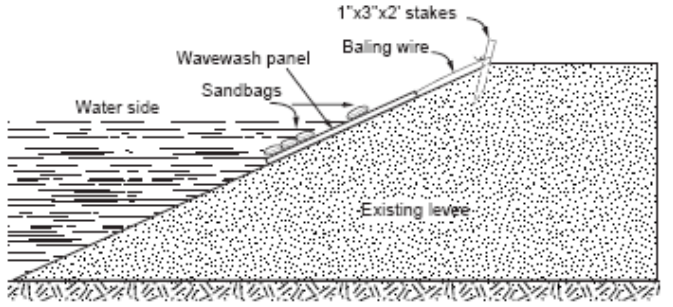
Visquine wave wash protection involves placing visquine (bought in 20-foot wide by 100-foot long by 10 mil rolls) along the waterside levee slopes. Wooden stakes are driven into the ground just above the levee shoulder to anchor the plastic in place. The stakes shall be 4 feet apart and staggered 1 foot, avoid driving stakes in a straight line; which may cause cracking and sloughing of the slope. In addition, sandbags are placed at the bottom of the plastic to provide weight and tie-down buttons are used to hold the plastic against the levee slope.



When using plastic, take caution in strong winds. Wind can catch plastic causing it to billow and endanger personnel trying to place it. All seams should be secured with sandbags.

Wood Panel Wave Erosion Protection

Panels are generally prefabricated, 3-feet high, and 16-feet long. Visquine is preferred, but wood panels may be required in channels with high velocities. The panels will be secured to the levee face with bailing wire, wood stakes, and sandbags. Wooden stakes (1" x 3" x 2') should be driven into the levee shoulder 4 feet apart with a stagger of 1 foot between rows. Baling wire is tied to the wooden panels and use to tie sandbags to the bottom half of the panels to weigh them down. Panels should overlap by 1 foot and face downstream. One or more panels can be wired together if more than 3 feet of slope protection is needed.



NOTE: Panels may be placed in a vertical position, depending on existing conditions.

ARMORING THE INBOARD LEVEE SLOPES AND ANY OTHER NECESSARY AREAS WITH ROCK TO PREVENT WAVE WASH EROSION

FF-S-3

SOURCE: Ref. 6

RESPONSIBLE PARTY: DWR, CCC, CDF, USACE

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

This response action will be utilized when strong winds accompany high water to prevent wave erosion of levee slopes. Levees adjacent to wide stretches of water should be watched during periods of strong wind to detect the early stages of wave erosion. During sustained periods of strong wind and high water, personnel should stand by to observe and monitor the effected areas. Before placing rock on levee slopes, it should be determined if protecting levee slopes with plastic or visquine would be sufficient.

ACTION CHARACTERISTICS

Objective: Flood Fight and Levee Repair
Timeframe: Short-term
Type: Physical

IMPACT:

Visquine and wood panels can be used to temporarily prevent or protect slopes from wave erosion. Rock slope protection should be used in situations where personnel cannot access the site and rock can be placed by barge or, in situations that required more permanent or longer-term solution.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	M	M	H	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

During this response action, riprap or rock slope protection is strategically placed to armor levee slopes. The rock may be placed by truck or waterside barge. The rock slope protection prevents scour and erosion and helps fortify already weakened levees, rebuilding the appropriate levee geometry.

The size of the riprap shall be appropriate for the velocity of the channel; the higher the velocity, the larger the size and weight the rock should be. Ideally, filter material or bedding should be placed between the existing levee slope and the riprap. Regular maintenance of protected slopes will ensure longer-term slope protection.

DWR Photo, Jones Tract Press Release Archives

PROVIDING FLOOD FIGHT EFFORTS ON NEIGHBORING ISLANDS THAT MAY SUSTAIN INCREASED SEEPAGE DISTRESS

FF-S-4

SOURCE: Ref. 6

RESPONSIBLE PARTY: DWR, CCC, CDF, USACE

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

These response actions will protect levees slopes and prevent seepage and boils from compromising weakened levees. This response action pertains to levee areas that have not yet breached, but have been weakened due to the earthquake movement and seepage. The reinforcements to the weakened levees are temporary methods and cannot be expected to last for extended periods of time. The emergency repair methods may include slope protection and boil control.

ACTION CHARACTERISTICS

Objective: Flood Fight and Life Safety
Timeframe: Short-term
Type: Physical

IMPACT:

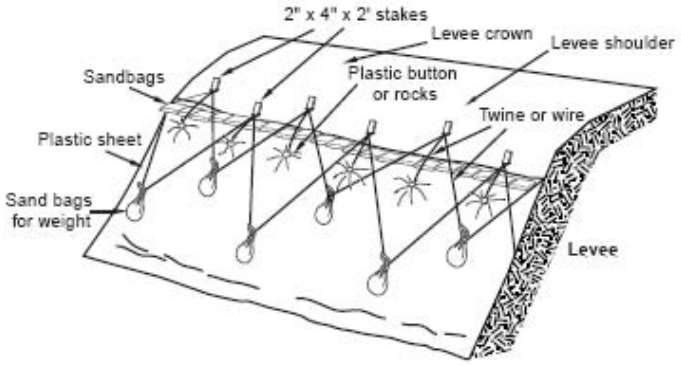
The emergency repair methods are used to prevent levee failure. Temporary flood fight methods have been utilized by DWR and the USACE for many years and have proven very effective at protecting weakened or endangered infrastructure.

Constraints/Limitations

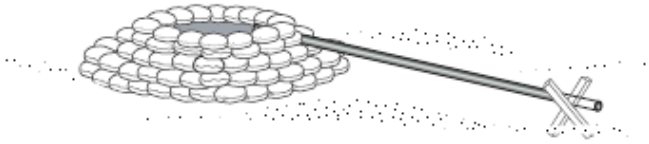
Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	L	L	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

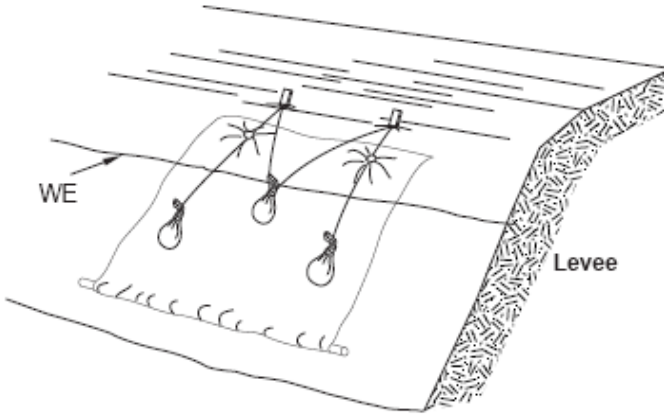
To prevent further saturation of levees slopes, visquine can be laid down to protect the levee. The visquine is anchored by wood stakes driven into the ground every 4 feet and staggered by 1 foot. Sandbags are draped from stakes to provide weight on the visquine.



Boils occur when water seeps under a levee and resurfaces on the landside; it can impact the integrity of the levee structure. If left uncontrolled, boils can carry enough levee material away and increase erosion within the levee enough to cause a levee break. The common method for controlling a boil is to create a watertight sandbag ring around it. The boil should not be covered nor should flow be stopped, because the boil may then erupt elsewhere.



If the location of the seepage point can be identified on the waterside of the levee, plastic can be used to cover the inlet hole, similar to visquine slope protection shown above.



DEVELOP AN OVERALL INCIDENT WATER MANAGEMENT RESPONSE STRATEGY — WS-S-1

SOURCE: Ref. 1, Ref. 2

RESPONSIBLE PARTY: DWR Incident Command, DWR O&M, and USBR-CVO

REGIONS AFFECTED: Deltawide and Export Areas

RESPONSE ACTION DESCRIPTION:

Develop a big-picture water management response strategy for addressing the full length of the incident within 72 hours, considering especially the following:

- Number and location of islands flooded and the flooding volume;
- Delta inflow;
- Time of year;
- Type of water year;
- Amounts of upstream storage;
- Amounts of South-of-Delta storage;
- Initial forecast of salinity intrusion;
- Initially estimated lengths of time of various disruptions and repairs;
- Environmental issues; and
- Other dimensions of the overall emergency (e.g., urban area damage from an earthquake).

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Short-term
Type: Operational

IMPACT:

This strategy will guide water operations throughout the remainder of the incident. Initially, it should be an overview strategy setting forth a statement of major controlling factors, a general approach, goals for the response, and the rationale for this strategy rather than some other. Obviously, the initial strategy may need to be revised, but the hope would be that the initial broad strategy would be workable for the full term of the incident and that it could serve as guidance for considering more detailed questions in defining specific response actions.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	L	L	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

A primary difficulty in developing an overall strategy is the complex interaction of the factors listed above combined with not knowing important aspects of what the future holds. In particular it cannot be

known whether the next winter season will bring sparse or bountiful precipitation. It cannot be known how well repair efforts will progress, and the cooperative spirit needed among all affected parties may or may not develop.

A sample strategy document and an explicit procedure that can be used to create it will be helpful. Training of the strategy team, including scenario exercises, will facilitate more efficient and effective work when these people are faced with a real emergency. These exercises will assist in identifying the needed participant skills and information resources as well. It is anticipated that the lead hydrodynamic modeler and the lead reservoir management evaluator will be participants in this strategy team and that their analytical results will support strategy development.

The strategy team should be mobilized immediately and begin developing its information inputs as the first day unfolds, so that the initial sketch of the approach can be quickly outlined. In some situations the only workable approach will be obvious.

For example, if the incident occurs in the late fall of a dry or critical year with low reservoir storage, small releases may be made to hold back salt intrusion while the islands are flooding. However, these releases will soon be cut to a minimal amount (hopefully enough to keep the salinity from dispersing further). The key strategic concept, however, will be to prevent the situation from getting worse and hope for a wet winter. A contingency plan will be needed for a dry winter.

Similarly, if the incident occurs in late spring and the past winter has been wet, then it may be reasonable to increase releases further with the goal of flushing the Delta and resuming exports within a couple months. In this case, reservoir management and hydrodynamic forecasts will be especially important.

In many other cases, the situation will not have an obvious approach. It will be necessary to analyze carefully some ideas that turn out to be unsatisfactory before settling on the approach that seems best.

CONDUCT LONGER-TERM HYDRODYNAMIC AND RESERVOIR MANAGEMENT MODELING

WS-S-2

SOURCE: Ref. 1, Ref. 2

RESPONSIBLE PARTY: DWR O&M and USBR-CVO

REGIONS AFFECTED:
Deltawide

RESPONSE ACTION DESCRIPTION:

Extend initial hydrodynamic modeling and reservoir management evaluations as needed in support of water operation strategy development and evaluation of specific actions for strategy implementation.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Short-term
Type: Operational

IMPACT:

The results of these analyses will be essential to incident water operations managers in evaluating potential actions and reaching decisions.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	L	L	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary difficulty in performing these analyses will be the pressing need for rapid responses. The WAM being developed by DRMS is designed to perform such analyses quickly in the context of a risk analysis. It will need some adaptation for the task envisioned here, but this should be readily accomplished. More detailed models can then be used for examining proposed actions in more detail and refining them as necessary.

REVIEW AND CONFIRM OR REFINE ALL DAY-1/IMMEDIATE ACTIONS

WS-S-3

SOURCE: None

RESPONSIBLE PARTY: DWR O&M and USBR-CVO

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

Review each of the actions already implemented in light of the overall water operations response strategy developed for the incident. This includes review of Delta inflow targets and associated releases from each of the reservoirs for which release increases were implemented – New Melones, Folsom, Oroville, and Shasta.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Short-term
Type: Operational

IMPACT:

The results of this review will implement the overall incident water operations strategy and ensure the appropriate use of upstream stored water for the foreseen duration of the incident.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Flow Multi-Island	M	L	L	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Specific actions taken will need to be reviewed regularly. Some (such as barrier removal or installation) are quite definitive and are difficult to fine-tune or reverse. Others, such as reservoir release rates, are expected to receive adjustments over time, especially since initial release rates were set before the overall water operations strategy was defined.

REQUEST RESERVOIR RELEASES FROM SAN JOAQUIN AND EAST DELTA TRIBUTARIES

WS-S-4

SOURCE: DWR Staff

RESPONSIBLE PARTY: DWR O&M and USBR-CVO

REGIONS AFFECTED: South, Central

RESPONSE ACTION DESCRIPTION:

Request San Joaquin and East Delta Tributary reservoir owners to make emergency releases to enhance Delta salinity repulsion and flushing efforts. Reservoirs include Camanche, New Hogan, New Don Pedro, and Lake McClure.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Short-term
Type: Operational/Physical

IMPACT:

Increasing releases from San Joaquin and East Delta tributary reservoirs will increase river flows into the Delta for filling flooding islands, repelling salt, and flushing Delta channels. This is particularly valuable for these tributaries, since they feed the east and south Delta that typically receive low flows and are difficult to flush.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	L	L	M	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation or constraint in implementing this action is the need for very careful and respectful communication of the request to San Joaquin Valley reservoir owners. It must be recognized that the request depends totally on voluntary cooperation by the reservoir owners.

REQUEST SACRAMENTO VALLEY WATER USERS TO CURTAIL DIVERSIONS — WS-S-5

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR O&M and USBR-CVO

REGIONS AFFECTED: North, Central

RESPONSE ACTION DESCRIPTION:

Request Sacramento Valley water users to curtail diversions until the flooding islands have filled and a flushing program to freshen the Delta is well underway. This can be accomplished by water-user postponement, the reduction of irrigation, or by switching to groundwater.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Short-term
Type: Operational/Physical

IMPACT:

Curtailing Sacramento Valley diversions will leave more water in the river for filling flooding islands, repelling salt, and flushing Delta channels.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	L	L	L	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation or constraint in implementing this action is the need for very careful and respectful communication of the request to Sacramento Valley water users. It must be recognized that the request depends totally on voluntary cooperation by water users.

REQUEST SAN JOAQUIN VALLEY WATER USERS TO CURTAIL DIVERSIONS — WS-S-6

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR O&M and USBR-CVO

REGIONS AFFECTED: South, Central

RESPONSE ACTION DESCRIPTION:

Request San Joaquin Valley water users to curtail diversions until the flooding islands have filled and a flushing program to freshen the Delta is well underway. This can be accomplished by water-user postponement, the reduction of irrigation, or by switching to groundwater.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Short-term
Type: Operational/Physical

IMPACT:

Curtailing San Joaquin Valley diversions will leave more water in the river for filling flooding islands, repelling salt, and flushing Delta channels.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	L	L	L	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The primary limitation or constraint in implementing this action is the need for very careful and respectful communication of the request to San Joaquin Valley water users. It must be recognized that the request depends totally on voluntary cooperation by water users.

REMOVE TEMPORARY SOUTH DELTA BARRIERS TO INCREASE CIRCULATION AND FLUSHING

WS-S-7

SOURCE: Ref. 1, DWR Staff

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: South

RESPONSE ACTION DESCRIPTION:

If temporary agricultural or fish barriers are installed and export pumping has been halted, consider removal of the temporary barriers to facilitate improved South Delta channel circulation and flushing. Confirm a beneficial impact with incident-specific hydrodynamic modeling before implementation.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Short-term
Type: Physical

IMPACT:

With no export pumping, barrier removal may allow tide cycles to cause net movement of channel waters toward the mouth of the Delta thereby enhancing South Delta flushing.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic	M	M	L	L	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

This action was identified by DWR staff but not included in a reference document. There is a need to confirm that it will create a positive impact before implementation. Impact is likely to vary based on specific Delta levee breach locations and inflows (especially of the San Joaquin River). If the fish barrier at Old River at Head is removed, coordination should occur with fish agencies through the CALFED Operations Group. Agricultural barrier removal should not be a problem as long as there is no pumping, since the barriers are installed to maintain water levels when pumping is occurring. Agricultural users should benefit from the improved circulation with barrier removal.

GOVERNOR RELAXES EXISTING WATER QUALITY AND ENVIRONMENTAL STANDARDS — GS-M-1

SOURCE: Ref. 2

RESPONSIBLE PARTY: Governor, State of California

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

- The response to a levee failure is governed in large measure by the impact of the failure on water quality.
- Based on the degree of response efforts, it may be necessary for the Governor to relax water quality and environmental requirements for quicker implementation of response efforts to protect life safety.

ACTION CHARACTERISTICS
Objective: General and Life Safety
Timeframe: Mid-term
Type: Legal

IMPACT:

The quality of the water for drinking, agricultural, and environmental uses may be impacted.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Winter	M	M	M	M	M
Summer	H	H	H	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- Studies done by the USACE indicate that, in general, a flooded island in the Delta (west or east) tends to have similar adverse long-term effects on water quality when Delta outflow and export pumping are at a minimum and considerably less effect when either the outflow or pumping is larger.
- In 1972, there was the Brannan-Andrus Island flood that brought large quantities of salt water into the Delta and created severe problems with the CVP, including the Contra Costa Canal and the SWP.
- An economic analysis by the Department of water Resources to evaluate water quality benefits that would result from restoring flooded islands suggest that there is little effect on water quality of the SWP.
- Agriculture is the main local use of Delta water. In the event of a levee failure, local use could be impacted because available water may not be acceptable for agriculture or available water may be acceptable for agriculture use but it may be necessary to temporarily suspend local delta diversions to restore suitable quality for urban use.
- There are multiple reasons for the differences in degree of saltwater intrusion such as location of the failure, season of the failure, and release of water to flush the Delta.

- Decision 1641 requires Delta-Mendota Canal water quality of no higher than 250 mg/L chloride. Contractual requirements are for total dissolved solids (TDS) in mg/L of no higher than:
  - 800 daily;
  - 600 monthly;
  - 450 annual; and
  - 400 5-year.
- The most critical of the standards is probably the 800 mg/L daily TDS for delivery of water to Mendota Pool under USBR water contracts.
- To minimize damage from salinity intrusion following a levee break, a hydraulic barrier must be reestablished to prevent the tides from pushing seawater upstream into the Delta. This could be accomplished by increasing freshwater inflow. During controlled hydrologic conditions, large amounts of additional water would have to be released from project reservoirs to flow through the Delta for salinity control and flushing. Water supply availability will be a major factor in determining if reservoir releases will be used in an emergency.
- Salt water intrusion into the Delta may make it necessary to temporarily alter the distribution of flow in Delta channels to flush as much salt as possible back to Suisan Bay. This would decrease the amount of salt that would have to be taken out of the Delta through the SWP, Central Valley project and other diversions. Barriers could be used to contribute to the effort to minimize salt-water intrusion.
- More than 40 salinity observation stations in the Delta are monitored by DWR and the USBR.
- The Department of Health has established maximum containment levels for secondary drinking water. Municipal and industrial purpose water quality standards compare to the secondary drinking water standards; relaxing the health limits or any other water quality standards may have to be considered during an emergency.

RESTORATION OF POWER TO NON-FLOODED ISLANDS TO ALLOW RETURN PUMPS TO REMOVE APPLIED AND SEEPAGE WATER

GS-M-2

SOURCE: DWR Staff

RESPONSIBLE PARTY: Local power suppliers/utility companies

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

- This action includes the restoration of power.

ACTION CHARACTERISTICS

Objective: General and Life Safety
Timeframe: Mid-term
Type: Operational/Physical

IMPACT:

Restoration of power would enable use of pumps to remove water from islands.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	L	M	M	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- Section 12981 of the CWC was amended whereby the State Legislature now recognizes that it may not be economically justifiable to maintain all Delta islands.

PLACE RIPRAP AND WAVE EROSION PROTECTION ON THE INTERIOR OF FLOODED ISLANDS

FF-M-1

SOURCE: Ref. 2, Ref. 7

RESPONSIBLE PARTY: DWR DFM

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

This response action will be utilized when strong winds accompany high water to prevent wave erosion of levee slopes. Levees adjacent to wide stretches of water should be watched during periods of strong wind to detect the early stages of wave erosion. During sustained periods of strong wind and high water, personnel should stand by to observe and monitor the effected areas. Visquine and wood panels can be used to prevent or protect slopes from wave erosion. Placement of riprap can also protect levee slopes from wind erosion and is a longer-term action.

ACTION CHARACTERISTICS

Objective: Flood Fight and Levee Repair
Timeframe: Mid-term
Type: Physical

IMPACT:

The emergency repair methods are used to minimize flood damage.

Constraints/Limitations

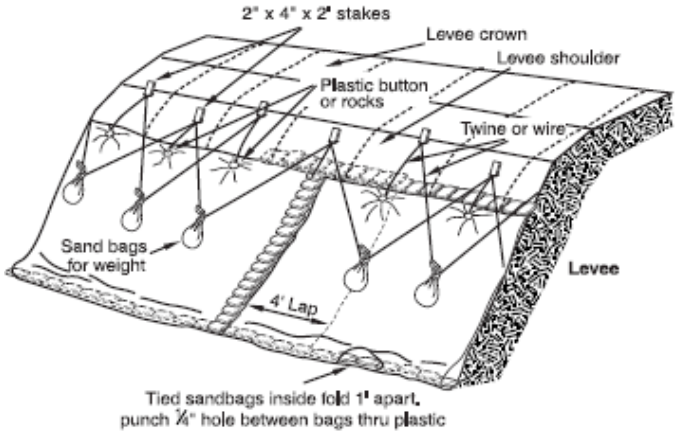
Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Visquine	M	L	L	L	L
Wood Panel	M	M	L	L	M
Riprap	M	M	H	M	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Wave erosion protection can be fabricated with plastic (Visquine) or wood panels for temporary solutions or riprap can be placed to provide longer-term protection, as summarized below.

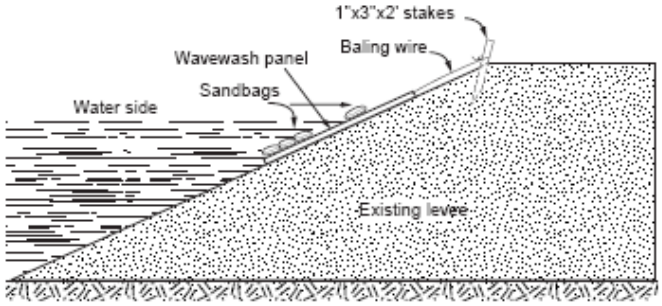
Visquine Wave Erosion Protection

Visquine wave wash protection involves placing visquine (bought in 20-foot wide by 100-foot long by 10 mil rolls) along the waterside levee slopes. Wooden stacks and sandbags are used to anchor the visquine to the levee slope.



Wood Panel Wave Erosion Protection

Wood panels are generally prefabricated, 3-feet high, 16-feet long, and are secured to the levee face with bailing wire, wood stakes, and sandbags.



NOTE: Panels may be placed in a vertical position, depending on existing conditions.

Riprap Wave Erosion Protection

Riprap or rock slope protection can be strategically placed by trucks or barges to armor levee slopes. The rock slope protection prevents scour and erosion caused by wave action. The size of the riprap shall be appropriate for the velocity of the channel; the higher the velocity, the larger the size and weight the rock should be. Ideally, filter material or bedding should be placed between the existing levee slope and the riprap. Regular maintenance of protected slopes will ensure longer-term slope protection.

ARMORING THE EDGES OF THE LEVEE BREACH TO PREVENT THE BREACH FROM WIDENING

FF-M-2

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR DFM

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

This action will occur in the event of a levee breach. When a breach occurs, two levee ends are exposed to further erosion and result in levee widening of the breach if the ends are not addressed. The edges of the breach will be armored with rock protection to prevent further erosion or widening of the breach. This action will generally be conducted by rock barge to prevent having personnel on an unstable levee.

ACTION CHARACTERISTICS

Objective: Flood Fight and Levee Repair
Timeframe: Mid-term
Type: Physical

IMPACT:

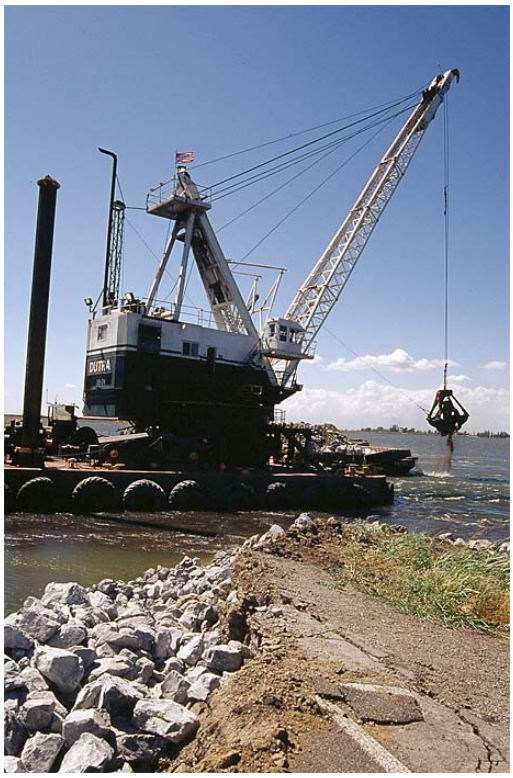
The emergency repair method will prevent the breach from widening and the release of saline water into the Delta.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	M	M	H	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The following illustrates how rock is placed to armor a levee breach.



DWR Photo, Jones Tract Press Release Archives

INSTALL TEMPORARY BARRIERS IN THE SACRAMENTO RIVER AND STEAMBOAT SLOUGH TO INCREASE DELTA CROSS CHANNEL FLOW

WS-M-1

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR

REGIONS AFFECTED: North, Central, South

RESPONSE ACTION DESCRIPTION:

This concept consists of placing rock barriers at the Sacramento River confluence of Steamboat Slough and on the Sacramento River downstream of Georgiana Slough. The objective of these barriers is to maximize delivery of Sacramento River freshwater flows into the Central and South Delta via the Delta Cross Channel and Georgiana Slough. The barriers maintain flow into the main Sacramento River channel, while developing increased head in the Sacramento River to force additional flow into the Delta Cross Channel and Georgiana Slough.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Mid-term
Type: Physical

IMPACT:

Fresh water flow is maintained in the Sacramento River channel and is also diverted to the Delta Cross Channel and Georgiana Slough in order to maximize the fresh water pool in the Central/South Delta available for flushing intruded salinity and for export. The amount of saltwater intrusion at the pumps and the period of disruption to exports are reduced.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Permitting for Prep Work	H	H	H	H	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Preliminary design of these barriers is needed to further evaluate the magnitude of effort and the degree of complications involved. It is anticipated that levees must be fortified and channel dredging may be necessary to accommodate the increased flows associated with this concept. Environmental, time, and cost requirements are high due to the preparatory efforts involved in fortifying the levees to facilitate the emergency barrier installation.

INSTALL TEMPORARY BARRIERS AROUND FRANKS TRACT — WS-M-2

SOURCE: Ref. 17

RESPONSIBLE PARTY: DWR

REGIONS AFFECTED: Central, South

RESPONSE ACTION DESCRIPTION:

This concept consists of installing temporary salinity control barriers at various locations near Franks Tract that include Three Mile Slough, False River, West False River, Sand Mound Slough, Old River, and Holland Cut. These barriers would serve a similar purpose to the operable gates suggested by the pilot project which obstructs flow during periods of the year when salinity levels at water export locations reach unacceptable levels.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Mid-term
Type: Physical

IMPACT:

The objectives of the temporary barriers include improving water quality at export locations during certain times of the year, especially under dry or below normal water year types. The temporary barriers may also potentially benefit fisheries, recreation, and other aquatic ecological resources.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Permitting	H	H	H	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The temporary barriers would be rock installations placed as emergency actions assuming that the permanent operable barriers had not yet been installed.

INSTALL TEMPORARY BARRIER ON THE SAN JOAQUIN RIVER UPSTREAM OF ROUGH AND READY ISLAND

WS-M-3

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: South

RESPONSE ACTION DESCRIPTION:

Install a temporary barrier (likely of rock and similar in concept and design to the South Delta temporary barriers) in the San Joaquin River upstream of Rough and Ready Island. The barrier would span the full channel width. Include a spilling feature so that higher San Joaquin flows can overflow if they occur. Include provisions to rapidly breach/remove the barrier in case of flood flows. Include submerged pipe-culverts with flap gates so that higher downstream water levels (on flood tides) can flow upstream through the barrier. Include the capability to shut off the upstream conduit flow. Remove existing South Delta temporary barriers, if still installed (Old River at Head, Middle River, Grant Line Canal, and Old River).

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Mid-term
Type: Physical

IMPACT:

The San Joaquin River temporary barrier will cause water upstream of the barrier to flow through the head of Old River, into the South Delta channels, and downstream to flush those channels. The diverted water may come from reservoir releases upstream of the San Joaquin River, or the water may flow through the barrier conduits on high tides and then through Old River at Head and the South Delta channels as the tide ebbs (this is tidal pumping). Operators need to control the backflow through the barrier conduits so it can be prevented if the downstream San Joaquin River water is saline. The backflow is desirable if Cross Channel flows from the Sacramento River or releases from east Delta tributaries have freshened the San Joaquin River in the downstream reach. Care must be taken to prevent worsening damage from San Joaquin floods.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Winter	L	M	L	M	M
Summer	L	M	L	M	M
Spring/Fall	M	M	L	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

This barrier is a desirable enhancement of South Delta flushing, provided fresh flushing water is available from either upstream releases on the San Joaquin River or freshened flows in the reaches downstream of

the barrier site. The main complication is making provisions to accommodate winter flood flows. It may be infeasible to have the barrier in place during the flood season. DWR should consider installation of an operable barrier in this location as a future emergency response provision.

INSTALL OR REINSTALL THE NORMAL DWR SOUTH DELTA TEMPORARY BARRIERS — WS-M-4

SOURCE: Ref. 3. Ref. 8

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: South

RESPONSE ACTION DESCRIPTION:

This concept consists of reinstalling the normal DWR South Delta temporary barriers when export resumes, if warranted.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Mid-term
Type: Physical

IMPACT:

The fish barrier located at Old River at Head is normally installed during defined periods in the spring and fall and is intended to keep migrating fish in the San Joaquin River. If the South Delta channels are sufficiently improved (especially if they are improved enough for export pumping to begin), normal installation of the fish barrier should be considered, in consultation with fish agencies.

The three agricultural barriers in the South Delta are intended to keep channel water levels high when export pumping is occurring to facilitate irrigation withdrawals. If export pumping has resumed, normal installation of agricultural barriers would be expected. If pumping has not resumed, water levels would not be adversely affected and the barriers would not be needed.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Spring/Fall	M	M	L	M	M
Summer	L	M	L	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Installation and removal of these temporary barriers is a normal DWR annual operation. They may have been removed as an emergency measure while export pumping was suspended, in order to facilitate flushing of the South Delta channels. When export pumping resumes, even at a reduced level, reinstallation of the temporary barriers should be expected. DWR's proposed construction of operable barriers to replace annual installation and removal of temporary barriers will enhance emergency response capabilities.

CHOOSE TO NOT RECOVER/DEWATER SELECT ISLANDS — GS-L-1

SOURCE: Ref. 2, Ref. 6, Ref. 9

RESPONSIBLE PARTY: DWR and OES

REGIONS AFFECTED: Deltawide

RESPONSE ACTION DESCRIPTION:

- Section 12981 of the CWC was amended whereby the State Legislature now recognizes that it may not be economically justifiable to maintain all Delta islands.
- There may be instances where complete reclamation including breach closure and pump out is not economically justified solely from a State-level perspective.

ACTION CHARACTERISTICS
Objective: General and Life Safety
Timeframe: Long-term
Type: Legal/Operational

IMPACT:

There is a financial impact to the State to recover and not recover selected Delta islands. The State is proceeding with an interim policy to stabilize Delta islands with the need for DWR to meet with all stakeholders to determine if it is in the best interest of all involved to proceed with full reclamation of the flooded island.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	H	H	M	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

- An economic analysis by DWR to evaluate water quality benefits that would result from restoring flooded islands suggest that there is little effect on water quality of the SWP.
- The Delta is of major statewide significance for many reasons. Drinking water supplied to about two-thirds of California's population flows through it; there are critically important environmental, agricultural, and recreational benefits in the region; and there are extensive infrastructure and capital investments in the area. Such investments include homes, businesses, towns, State highways, rail lines, natural gas fields, gas and fuel pipelines, and drinking water pipelines (e.g. Mokelumne Aqueduct). Even so the State recognizes that it may not be economically justified to reclaim flooded islands in each and every flood scenario.
- During the last century, there have been 162 levee failures leading to island inundations.
- While DWR remains committed to its flood fight mission to prevent loss of life and to reduce property damage, there may be instances where complete reclamation including breach closure and pump out is not economically justified solely from a State-level perspective. When multiple parties (e.g. private landowners, adjacent island landowners, private and public utilities, water exporters, etc.)

stand to benefit from full reclamation of a flooded island, the cost benefits and cost sharing determinations should be clearly determined prior to commencing the full reclamation project.

- Recommended Interim Policy
  - Using existing authorities and funding, DWR, after consultation with OES, may conduct emergency flood operations to stabilize a Delta island levee failure.
  - During Phase I the State, through OES and DWR, would seek to create an annually renewable emergency fund for responding to island flooding incidents in the Delta. This fund would be available for immediate emergency response and stabilization following a levee failure and island inundation.
  - The purpose of the fund would allow DWR to stabilize the emergency in the event that the scope and nature of the incident fell outside the PL 84-99 emergency assistance authority of the USACE. The stabilization would also provide time for DWR to meet with all stakeholders to determine if it was in the best interest of all involved to proceed with full reclamation of the flooded island.
  - It should also be made clear that initial stabilization may not be performed under certain circumstances, such as where island flooding is part of the designed or accepted hydrologic process (e.g. Prospect Island), as determined by DWR in consultation with OES.
- Transition from Stabilization to Full Reclamation
  - Many Delta levees and drainage systems protect beneficial land uses and critically important infrastructure including agriculture, water quality for the SWP and CVP, highways, railroads, gas and petroleum pipe lines, power transmission lines, aqueducts, appurtenant structures, and other facilities. While the State may take a leadership role in conducting a flood fight to stabilize a levee failure or other emergency situation, a fair and reasonable cost sharing agreement by all Federal, State, and local beneficiaries is necessary if the island is going to be reclaimed (breach closure and pump out). After the initial stabilization has been achieved, a detailed evaluation of the extent of State-level and other stakeholder interest should be completed before proceeding with full reclamation of the flooded island. Full reclamation would only proceed if there was a compelling State interest and if other beneficiaries joined in agreements to appropriately share the costs.
- A goal of the ongoing DRMS study is to provide sufficient information to better quantify the State's interest for reclaiming specific islands in the Delta. Upon completion of the study, this Interim Policy would be further revised to include determinations of the level of State response to levee breach incidents on specific islands in the Delta.
- A recommended strategy in responding to California's flood crisis report is to evaluate potential policies and procedures that may determine the State's capacity to fund levee maintenance, infrastructure improvements, and emergency response in the Delta.
  - DWR and the California Bay-Delta Authority have committed to carrying out a Comprehensive Program Evaluation for the California Bay-Delta Authority Delta Levees Program. As part of the Comprehensive Program Evaluation or concurrently with it, the State should prioritize which islands and levees should be maintained and protected, and to what levels.

CLOSE LEVEE BREAK(S) FF-L-1

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR DFM

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

As quickly as possible, crews will be mobilized to levee break areas. Based on aerial reconnaissance, crews may work from land or water to place rock or sand bags to close the breach.

ACTION CHARACTERISTICS
Objective: Flood Fight and Levee Repair
Timeframe: Long-term
Type: Physical

IMPACT:

Breach closure will prevent further water from flooding the island and minimize saltwater intrusion into the Delta.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	H	H	H	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The following photos illustrate breach closures:

DWR Photos, Jones Tract Press Release Archives

BREACH CLOSURE AND PUMP OUT WOULD NOT COMMENCE UNTIL THE ECONOMIC FEASIBILITY AND BENEFITS OF FULL RESTORATION HAVE BEEN DETERMINED

FF-L-2

SOURCE: Ref. 6

RESPONSIBLE PARTY: DWR

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

Breach closure may be considered a lower priority during response, once the ends of the breach have been armored, so closure and pump out may not occur for some time following an event. Once a breach has been closed, the decision to restore an island must be made. Restoration includes setting up pumps and discharging water that flooded the island during a breach. The decision to restore an island will be made using DWR's Interim Levee Repair Policy as guidance.

ACTION CHARACTERISTICS

Objective: Flood Fight and Levee Repair
Timeframe: Long-term
Type: Physical

IMPACT:

The impact of this action would be some islands may not be recovered.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Any Event	H	H	H	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The following photographs illustrate pump out procedures on Jones Tract in 2004:

DWR Photos, Jones Tract Press Release Archives

MONITOR DELTA SALINITY, ADJUST RESERVOIR RELEASES, AND RESUME PUMPING

WS-L-1

SOURCE: Ref. 1, Ref. 2, Ref. 3

RESPONSIBLE PARTY: DWR O&M, USBR-CVO

REGIONS AFFECTED:
Deltawide

RESPONSE ACTION DESCRIPTION:

Monitor Delta salinity changes resulting from Delta flushing and levee repair efforts, adjust reservoir releases to balance available storage with Delta salinity control needs, and (when possible) resume export pumping.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Long-term
Type: Operational/Physical

IMPACT:

When salinity repulsion and flushing have been relatively successful, reservoir releases can be adjusted to target maintenance of the Delta salinity distribution rather than additional flushing. This will require less reservoir releases than flushing, but significantly more than is required with no breached islands. As levee repairs progress, tidal mixing will be lessened and needed flows for Delta salinity control will decrease. At some point, based on upstream reservoir storage still available, releases can be made to support the resumption of pumping.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Flow Multi-Island	M	L	L	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Considering the tradeoffs involved for Delta flushing to reestablish a desirable Delta salinity distribution, maintenance of that distribution once established and releasing versus saving upstream reservoirs' stored water is a delicate and challenging balancing act. Spending large amounts of upstream water on flushing and then having none left to maintain the salinity distribution achieved would be a waste. Similarly, aggressive flushing and subsequent maintenance of a desired salinity distribution and having no reservoir storage left to support export pumping would seem to be out of balance.

The DRMS WAM has been designed to manage that balancing act by incorporating rules for deciding on reasonable amounts of reservoir releases while balancing upstream water demands, environmental demands, Delta salinity management needs, and support of export pumping. In addition to deciding on monthly reservoir releases, the WAM calculates the resulting salinity distribution in the Delta and then proceeds with the similar calculation for the next month. It computes results quickly and is, therefore, able to address a variety of "what if" questions. For example, What if the coming winter is wet? Or What if the coming winter is dry? Or what if the coming winter is about average? The WAM has just become

operational in the form needed for conducting the DRMS risk analysis. It is still undergoing testing and refinement. It will need some adaptation to serve the modeling needs of incident water managers. It will also need examination by SWP and CVP operators and managers to make sure the rules initially included in WAM reflect appropriate emergency operation policies. But those adaptations should be readily achievable. The WAM will be a valuable tool for incident water management in a prospective low-inflow, multiple island flooding events. It should be adapted and integrated into DWR's emergency response planning.

REPAIR DAMAGE TO EBMUD MOKELUMNE AQUEDUCT — WS-L-2

SOURCE: Ref. 2

RESPONSIBLE PARTY: EBMUD, likely joint responsibility

REGIONS AFFECTED: Local/ Varies by event location

RESPONSE ACTION DESCRIPTION:

This concept consists of repairing the 15-mile long section of the Mokelumne Aqueduct that crosses the South-Central Delta between the towns of Stockton and Bixler. The aqueduct consists of three parallel pipelines of diameters of 65, 67, and 87 inches, which together convey up to 325 million gallons per day (95% of EBMUD's water supply).

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Long-term
Type: Physical

IMPACT:

Benefits of aqueduct repairs would be primarily local, affecting mainly EBMUD customers. However, having the aqueduct online as a supplemental source of fresh water for other water districts or as a tool to augment regional Delta water quality under a state of emergency could be invaluable and widely beneficial.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic/Flood Damage Scenario	M	H	H	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

None.

REMOVE TEMPORARY BARRIERS AS A LONG TERM RESPONSE ACTION — WS-L-3

SOURCE: None

RESPONSIBLE PARTY: DWR

REGIONS AFFECTED: Local, potentially Delta-wide

RESPONSE ACTION DESCRIPTION:

This response action includes removal of temporary flow barriers put in place in the North, Central, or South Delta under the various water supply and water quality operation control measures. The flow barriers considered under these measures consist of rock mound closures, operable floating barriers, steel structural operable gates, and others. As a long-term response action, removal of these barriers is required to return the channels to their normal state of conveyance. The rock barriers must be removed using heavy construction equipment. Some of the other operable barriers are "removed" by returning them to the "open" position.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Long-term
Type: Physical

IMPACT:

These barriers are by definition temporary; thus they are to be removed when water supply and water quality conditions return to an acceptable state. The impact of removal is that the Delta channels will resume normal conveyance functions, with no other likely significant impacts.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Water quality conditions return to "normal"	L	L (operable barrier) to H (rock barrier)	L (operable barrier) to H (rock barrier)	L	L
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

The level of effort in terms of time and cost to remove rock barriers is expected to be substantially higher than that to remove any barriers designed to be operable.

CONNECT CONTRA COSTA CANAL TO MOKELUMNE AQUEDUCT TO PROVIDE WATER TO CCWD OR EBMUD

WS-L-4

SOURCE: Ref. 2

RESPONSIBLE PARTY: USBR, likely joint responsibility

REGIONS AFFECTED: Local

RESPONSE ACTION DESCRIPTION:

This concept involves constructing an inter-tie pipeline or canal between the Contra Costa Canal in the western Delta to the Mokelumne Aqueduct in the southwestern Delta. The project would likely include pumping capability so that exchanges could be made in either direction.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Long-term
Type: Physical

IMPACT:

CCWD would benefit from an inter-tie facility by receiving water supplies from the Mokelumne Aqueduct in the event that West Delta salinity levels were unacceptable for prolonged periods of time. EBMUD would benefit from a connection facility in the event their pipeline delivery infrastructure in the Delta were damaged and incapacitated by a seismic or flooding event.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic/Flood Damage Scenario	M	H	H	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

None.

INSTALL PIPELINE ON BENICIA-MARTINEZ BRIDGE TO TRANSFER WATER FROM NORTH BAY AQUEDUCT TO CCWD

WS-L-5

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR, CCWD

REGIONS AFFECTED: Local/ West Delta

RESPONSE ACTION DESCRIPTION:

This concept consists of installing a temporary pipeline on the Benicia-Martinez Bridge, which will carry North Bay Aqueduct – Benicia water to CCWD for minimal supply or blending.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Long-term
Type: Physical

IMPACT:

Restore service to CCWD by directing water supplies from the North Bay Aqueduct in the event that West Delta salinity levels were unacceptable for prolonged periods of time.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Prolonged Disruption	M	H	H	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

CCWD is extremely vulnerable to lengthy disruptions of Delta water exports. This emergency measure would provide some replacement or blending supply in a long outage. Pre-design work should be performed to size the facility and confirm the availability of needed equipment and material. Some long lead items may need to be purchased in advance to make the response action feasible.

INSTALL PIPELINE ON CARQUINEZ BRIDGE TO TRANSFER WATER FROM NORTH BAY AQUEDUCT OR MARIN COUNTY TO EBMUD OR CCWD

WS-L-6

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR, EBMUD, CCWD

REGIONS AFFECTED: Local/ West Delta

RESPONSE ACTION DESCRIPTION:

This concept consists of installing a temporary pipeline on the Carquinez Bridge, which will carry North Bay Aqueduct – Vallejo water or Marin County water to EBMUD or CCWD.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Long-term
Type: Physical

IMPACT:

Restore service to EBMUD and CCWD by directing water supplies from the North Bay Aqueduct in the event that West Delta salinity levels were unacceptable for prolonged periods of time.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Prolonged Disruption	M	H	H	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

CCWD is extremely vulnerable to lengthy disruptions of Delta water exports. EBMUD District could be severely impacted if the Mokelumne Aqueduct is severely damaged and EBMUD encounters difficulties in its planned approach for repairs. This emergency measure would provide some replacement or blending supply in a long outage. Pre-design work should be performed to size the facility and confirm the availability of needed equipment and material. Some long lead items may need to be purchased in advance to make the response action feasible.

USE THE CALIFORNIA AQUEDUCT CHECK STRUCTURES AND PUMPS TO REVERSE FLOW OF THE AQUEDUCT TO SUPPLY SOUTH BAY AQUEDUCT OR SOUTH DELTA

WS-L-7

SOURCE: Ref. 2

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: Local

RESPONSE ACTION DESCRIPTION:

This concept involves operating the California Aqueduct flow control structures and adding temporary pump facilities to essentially reverse the direction of conveyance, so that the system acts as a supply source for Bethany Reservoir rather than a withdrawal facility. Available California Aqueduct supplies, supplemented by San Luis, would be delivered to the South Bay Aqueduct.

ACTION CHARACTERISTICS
Objective: Water Supply and Water Quality Operations
Timeframe: Long-term
Type: Physical

IMPACT:

The objectives of operating the SWP facilities in reverse are to provide or augment water deliveries to the South Bay Aqueduct at times when normal exports are not possible. The benefits to South Bay Aqueduct water deliveries are expected to be moderate as the capacity and/or ability of the State aqueduct facilities to operate in reverse will be limited by the temporary pumping capacity installed at each check structure.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic/flood damage scenario	M	H	H	H	H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

None.

DREDGING OF STOCKTON DEEP WATER SHIP CHANNEL TO ALLOW RESUMPTION OF CARGO TRAFFIC TO THE PORT OF STOCKTON

WS-L-8

SOURCE: Ref. 7

RESPONSIBLE PARTY: Unknown

REGIONS AFFECTED: Local

RESPONSE ACTION DESCRIPTION:

This concept involves re-opening the route for cargo vessel transit to and from the Port of Stockton, Stockton Deep Water Ship Channel. The Ship Channel connects San Francisco Bay (Suisun and Grizzly Bay) to the East Delta at the Port of Stockton via primarily the San Joaquin River channel. The channel depth is maintained by periodic dredging. Under a seismic event, the dredged channel (levee) side-slopes may fail and slough into the channel, blocking vessel passage. The submerged slope failure would effectively close the Port of Stockton. Dredging would return the channel to its normal design depth and allow vessel traffic to resume.

ACTION CHARACTERISTICS

Objective: Water Supply and Water Quality Operations
Timeframe: Long-term
Type: Physical

IMPACT:

Resumption of operations at the Port of Stockton.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic levee slumping/ failure	M	H	H	H	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Time and cost requirements of this response action could be high if damage is significant to large extents of the Ship Channel.

APPENDIX F

Potential Future Response Actions

RELEASE CLIFTON COURT FOREBAY WATER ON LOW TIDES TO REPULSE SALINITY FROM SOUTH DELTA CHANNELS

TBD

SOURCE: No reference; new idea for analysis and consideration

RESPONSIBLE PARTY: DWR O&M

REGIONS AFFECTED: South

RESPONSE ACTION DESCRIPTION:

Clifton Court Forebay, with a capacity of more than 28,000 acre feet, is a large fresh water reservoir located in close proximity to the Delta and is positioned where it has maximum influence on South Delta water quality. Upon gate closure at the start of a low-Delta inflow, multi-island flooding event, the fresh water stored there is a uniquely valuable asset. Water managers may use it primarily to supply contractors, such as those on the South Bay Aqueduct, who do not have access to storage in San Luis. Another potential use is to carefully release part of the water to refill South Delta channels with fresh water rather than allowing maximum intrusion of saline water. The gates would need to be partially opened as the low water surfaces in local channel water levels were beginning to rise and the ideal amount of release would be just enough to hold the salinity front just upstream of the most upstream South Delta breach.

ACTION CHARACTERISTICS
Objective: Potential Future
Timeframe: TBD
Type: Physical

IMPACT:

If the release could be timed and controlled as desired, South Delta salinity levels might be kept from reaching unacceptable levels. This could facilitate a much earlier resumption of South Delta water use and export pumping than would otherwise be possible.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Flow Multi-Island	L	L	L	M	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Careful modeling will be needed to assess the potential benefits, required amounts, and timing of Clifton Court releases for South Delta salinity control. These results will need to be presented in terms of the earlier resumption of pumping that they would make possible and the extra quantities of export that would be realized.

BLOCK SALINE WATER FROM ENTERING THE SOUTH DELTA BY SINKING ROCK BARGES — TBD

SOURCE: No reference.

RESPONSIBLE PARTY: DWR

REGIONS AFFECTED: South Delta

RESPONSE ACTION DESCRIPTION:

This concept consists of the rapid deployment of barriers accomplished by sinking rock barges in strategic locations. These could be the same locations described for barrier deployment under "Block Saline Water from Entering the South Delta by Deploying Central Delta Barriers" and "Isolate Middle River by Fortifying Levees and Installing Barriers."

ACTION CHARACTERISTICS
Objective: Potential Future
Timeframe: TBD
Type: Physical

IMPACT:

Use of barriers to limit saltwater intrusion into the South Delta has been shown to be very effective, resulting in reduced salinity levels in the South Delta and a reduced period of export disruption. Introduction of temporary barriers requires fortification of levees and thus significant construction in advance of the defining event, as well as transfer of land from local landowners.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Seismic (low inflow)	H	H	H	H	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Levees must be fortified in conjunction with deployment of these temporary barriers; this is not a stand-alone measure. Sinking rock barges to create channel barriers is not considered feasible for a number of reasons:

- Controlled sinking may not be possible, particularly if barges are not compartmentalized;
- Controlled sinking of barges during periods of high channel velocities, such as those anticipated immediately following a seismic event would be nearly impossible to perform;
- Barges could collapse when resting on non-level ground
- Rock barges typically have a molded hull depth of 12 to 16 feet;
- Sinking a barge is not necessarily going to create a "barrier" as desired;
- Rock barges will be a valuable resource for any concurrent repair operations; and
- It is unlikely that they would be sunk when needed for other tasks.

Environmental, time, and cost considerations are high due to the efforts involved in fortifying the levees as part of the preparedness operations.

WIDEN THE DELTA CROSS CHANNEL GATE STRUCTURE — TBD

SOURCE: No reference; new idea for analysis and consideration

RESPONSIBLE PARTY: USBR-CVO

REGIONS AFFECTED: North, Central, South

RESPONSE ACTION DESCRIPTION:

The Cross Channel gate structure would be widened by constructing supplemental gates to one side of the existing gates. The project might include channel modifications in the Sacramento River such as a permanently submerged berm to better direct a portion of the river flow through the gates, modified gate design to allow partial opening when Sacramento flows are higher than 25,000 cfs, and Cross Channel improvements immediately downstream of the gates to prevent erosion. After the new gates were installed, the existing gates could be improved or replaced.

ACTION CHARACTERISTICS
Objective: Potential Future
Timeframe: TBD
Type: Physical

IMPACT:

Increasing the width of the Delta Cross Channel gates would provide the flexibility to increase the portion of Sacramento River flow diverted to the Central Delta to repulse or flush salinity in Delta emergencies. Designing the gates to allow partial opening for controlled diversions during high Sacramento River flow would provide a capability that does not now exist and would markedly improve water operators' ability to flush the Delta when salinity has intruded.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Low-Flow Multi-Island	M/H	H	M	M/H	M/H
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

An improved Cross Channel gate structure would be very desirable from an emergency-water-operations, salinity-management viewpoint. The environmental review process would be lengthy and contentious, even if analyses showed that the additional gate-operating flexibility provided opportunities to benefit endangered fisheries during normal periods.

BLOCK SALINE WATER FROM ENTERING THE SOUTH DELTA BY DEPLOYING CENTRAL DELTA BARRIERS — TDB

SOURCE: Ref. 1

RESPONSIBLE PARTY: DWR

REGIONS AFFECTED: South

RESPONSE ACTION DESCRIPTION:

This concept consists of rapidly deploying channel barriers along an east-west alignment of fortified levees in the South Delta, including

- Barriers at Holland Cut, Old River, and Middle River, combined with interconnecting levees along the south and east side of Holland Island, the south side of Quimby Island, the south side of Mandeville Island, and the west and north sides of McDonald Island;
- Barriers at Werner Cut, Old River, Middle River, and Whiskey Slough, combined with interconnecting levees along the south side of Holland Island, bifurcating Bacon Island, and continuing south of Empire Cut; and
- Barriers at Werner Cut, Old River, and Middle River, along with interconnecting levees immediately north of the Santa Fe Railroad and Mokelumne Aqueduct.

ACTION CHARACTERISTICS
Objective: Potential Future
Timeframe: TBD
Type: Physical

IMPACT:

Fortification of designated levees requires significant construction in advance of the defining event. Implementation will require transfer of land from local landowners. The results are anticipated to include reduced salinity levels in the South Delta and a shortened period of disruption to exports. In addition, the concept could involve protection enhancements of existing utility and transportation infrastructure, if relocated along the fortified interconnecting levee alignment.

Constraints/Limitations

Key Event Characteristic	Environmental	Time to Implement	$ (Cost)	Legal/ Contractual	Coordination
Permitting	H	H	H	H	M
Difficulty Scale: High (H), Medium (M), Low (L)					

Comments:

Barriers can be rock barriers, tethered barge, permanent or temporary hinged gates (such as Obermeyer), or slide gate structures. In all cases they should be used in conjunction with fortified levees.

Environmental, time, and cost requirements are high due to the efforts involved in fortifying the levees as part of the preparedness operation.